Hazardous Waste Section

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RCRA FACILITY INVESTIGATION

HSWA PERMIT NUMBER

NCD000604322

APPENDICES 1-1 THROUGH 2-5

AUG 1994
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AUGUST 1994

Singer Furniture Company
Plant No. 33
Lenoir, North Carolina 28695

Identification Number NCD 000 604 322
Permit Number NCD 000 604 322

Permit

Pursuant to the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 USC §6901 et seq., commonly known as RCRA) and regulations promulgated thereunder by the U.S. Environmental Protection Agency (EPA) (codified and to be codified in Title 40 of the Code of Federal Regulations), a permit is issued to Singer Furniture Company (hereafter called the Permittee), who operates a hazardous waste facility located in Lenoir, North Carolina latitude 35°53'45" North and longitude 81°33'00" West.

This Permit, in conjunction with the Hazardous Waste Permit issued by the State of North Carolina, constitutes the RCRA permit for this facility. The Permittee shall be required to investigate any releases of hazardous waste or hazardous constituents from any solid waste management unit at the facility regardless of the time at which waste was placed in such unit and to take appropriate corrective action for any such releases. The Permit also requires the Permittee to certify annually that on-site generation of hazardous waste is minimized to the extent practicable.

The Permittee must comply with all terms and conditions of this permit. This permit consists of the conditions contained herein (including those in any attachments) and applicable regulations contained in 40 CFR Parts 260 through 264, 266, 268, 270, and 124 as specified in the permit and statutory requirements of RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984, P. L. 98-616, (the RCRA amendments). Nothing in this permit shall preclude the Regional Administrator from reviewing and modifying the permit at any time during its term in accordance with 40 CFR §270.41.

This Permit is based on the assumption that the information and reports submitted to date, and subsequent to issuance of this permit by the Permittee are accurate. Any inaccuracies found in this information may be grounds for termination or modification of this permit in accordance with 40 CFR §270.41, §270.42, and §270.43 and potential enforcement action. The Permittee must inform EPA of any deviation from or changes in the information in the application which would affect the Permittee's ability to comply with the applicable regulations or permit conditions.

This Permit is effective as of July 30, 1988, and shall remain in effect until July 30, 1998, unless revoked and reissued, or terminated under 40 CFR §§270.41 and .43 or continued in accordance with 40 CFR §270.51(a).

6/29/88
Date

James H Scarbrough
for Patrick M. Tobin
Director
Waste Management Division

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I.A. EFFECT OF PERMIT

Compliance with this RCRA permit constitutes compliance, for purposes of enforcement, with Subtitle C of RCRA except for those requirements not included in the permit which become effective by statute or which are promulgated under 40 CFR Part 268 restricting placement of hazardous waste in or on the land. Issuance of this permit does not convey property rights of any sort or any exclusive privilege; nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local law or regulations. Compliance with the terms of this permit does not constitute a defense to any order issued or any action brought under Section 3013 or Section 7003 of RCRA, Sections 106(a), 104, or 107 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601 et seq., commonly known as CERCLA), or any other law providing for protection of public health or the environment.

I.B. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated for cause as specified in 40 CFR §§270.41, 270.42, and 270.43. The filing of a request for a permit modification, revocation and reissuance, or termination, or the notification of planned changes, or anticipated noncompliance on the part of the Permittee does not stay the applicability or enforceability of any permit condition.

I.C. SEVERABILITY

The provisions of this permit are severable, as specified in 40 CFR §124.16 and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

I.D. DUTIES AND REQUIREMENTS

I.D.1. Duty to Comply

The Permittee shall comply with all conditions of this permit, except to the extent and for the duration such noncompliance is authorized by an emergency permit. Any permit noncompliance, other than noncompliance authorized by an emergency permit, constitutes a violation of RCRA and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or denial of a permit renewal application.

I.D.2. Duty to Reapply

If the Permittee will continue an activity allowed by this permit after the expiration date of this permit, the Permittee

shall submit a complete application for a new permit at least 180 days before this permit expires, unless permission for a later date has been granted by the Regional Administrator.

I.D.3. Permit Expiration

If the State does not have RCRA hazardous waste permitting authority under 40 CFR Part 271 for the 1984 RCRA Amendments, this permit and all conditions herein will remain in effect beyond the permit's expiration date, as specified in 40 CFR §270.51, if the Permittee has submitted a timely, complete application in accordance with 40 CFR §270.10(c) and, through no fault of the Permittee, the Regional Administrator has not issued a new permit with an effective date under 40 CFR §124.15 on or before the expiration date of the previous permit.

If the state does have RCRA hazardous waste permitting authority under 40 CFR Part 271 for the 1984 RCRA Amendments and if the Permittee has submitted a timely and complete application under applicable state law and regulations, the terms and conditions of this permit continue in force beyond the expiration date of the permit, but only until the effective date of the state's issuance or denial of a state RCRA permit.

I.D.4. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

I.D.5. Duty to Mitigate

In the event of noncompliance with the permit, the Permittee shall take all reasonable steps to minimize releases to the environment, and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment.

I.D.6. Proper Operation and Maintenance

The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

I.D.7. Duty to Provide Information

The Permittee shall furnish to the Regional Administrator, within a reasonable time, any relevant information which the Regional Administrator may request to determine whether cause exists for modifying, revoking, and reissuing, or terminating this permit, or to determine compliance with this permit. The Permittee shall also furnish to the Regional Administrator, upon request, copies of records required to be kept by this permit.

I.D.8. Inspection and Entry

The Permittee shall allow the Regional Administrator, or an authorized representative, upon the presentation of credentials and other documents as may be required by law to:

I.D.8.a. Enter at reasonable times upon the Permittee's premises where a regulated activity is located or conducted, or where records must be kept under the conditions of this permit;

I.D.8.b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

I.D.8.c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated, or required under this permit; and

I.D.8.d. Sample or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by RCRA, any substance, or parameters at any location.

I.D.9. Monitoring and Records

I.D.9.a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The method used to obtain a representative sample to be analyzed must be the appropriate method from Appendix I of 40 CFR Part 261 or an equivalent method approved by the Regional Administrator. Laboratory methods must be those specified in the most recent edition of Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846 or Methods for Chemical Analysis of Water and Wastes,(EPA-600/4-79-020).

I.D.9.b. The Permittee shall retain at the facility, or other appropriate location as provided for under 40 CFR Part 264, records of all monitoring information required under the terms of this permit, including all calibration and maintenance records, records of all data used to prepare documents required by this permit, copies of all reports and records required by this permit, the certification

required by 40 CFR 264.73(b)(9), and records of all data used to complete the application for this permit for a period of at least 3 years from the date of the sample, measurement, report, certification or application, or until corrective action is completed, whichever date is later. These periods may be extended by request of the Regional Administrator at any time and are automatically extended during the course of any unresolved enforcement action regarding this facility.

I.D.9.c. Records of monitoring information shall specify:

I.D.9.c.i. The dates, exact place, and times of sampling, or measurements;

I.D.9.c.ii. The individuals who performed the sampling or measurements;

I.D.9.c.iii. The dates analyses were performed;

I.D.9.c.iv. The individuals who performed the analyses;

I.D.9.c.v. The analytical techniques or methods used; and

I.D.9.c.vi. The results of such analyses.

I.D.10. Reporting Planned Changes

The Permittee shall give notice to the Regional Administrator as soon as possible of any planned physical alterations or additions to the permitted facility. This would apply to all contiguous land, structures, other appurtenances and improvements on the land, used for the treatment, storage or disposal of solid waste.

I.D.11. Anticipated Noncompliance

The Permittee shall give advance notice to the Regional Administrator of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

I.D.12. Transfer of Permits

This permit may be transferred to a new owner or operator only if it is modified or revoked and reissued pursuant to 40 CFR §270.41(b)(2) or §270.42(d). Before transferring ownership or operation of the facility during its operating life, the Permittee shall notify the new owner or operator in writing of the requirements of 40 CFR Parts 264 and 270, the 1984 RCRA Amendments and this permit.

I.D.13. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any

compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

I.D.14. Twenty-four Hour Reporting

I.D.14.a. The Permittee shall report any noncompliance which may endanger human health or the environment. Any such information shall be reported orally within 24 hours from the time the Permittee becomes aware of the circumstances. This report shall include:

I.D.14.a.i. Information concerning the release of any hazardous waste or hazardous constituents which may endanger public drinking water supplies.

I.D.14.a.ii. Information concerning the release or discharge of any hazardous waste or hazardous constituents, or of a fire or explosion at the facility, which could threaten the environment or human health outside the facility.

I.D.14.b. The description of the occurence and its cause shall include:

I.D.14.b.i. Name, address, and telephone number of the owner or operator;

I.D.14.b.ii. Name, address, and telephone number of the facility;

I.D.14.b.iii. Date, time, and type of incident;

I.D.14.b.iv. Name and quantity of materials involved;

I.D.14.b.v. The extent of injuries, if any;

I.D.14.b.vi. An assessment of actual or potential hazard to the environment and human health outside the facility, where this is applicable, and

I.D.14.b.vii. Estimated quantity and disposition of recovered material that resulted from the incident.

I.D.14.c. A written report shall also be provided to the Regional Administrator within 15 days of the time the Permittee becomes aware of the circumstances. The written report shall contain the information specified under Condition I.D.14a. and b.; a description of the noncompliance and its cause; the periods of noncompliance (including exact dates and times); whether the noncompliance has been corrected; and if not, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

I.D.15. Other Noncompliance

The Permittee shall report all other instances of noncompliance not otherwise required to be reported above, at the time written

reports as required by this permit are submitted. The reports shall contain the information listed in Condition I.D.14.b. as appropriate.

I.D.16. Other Information

Whenever the Permittee becomes aware that it failed to submit any relevant facts or submitted incorrect information in any document(s) submitted to the Regional Administrator, the Permittee shall promptly submit such facts or information.

I.E. SIGNATORY REQUIREMENT

All applications, reports, or information submitted to the Regional Administrator shall be signed and certified in accordance with 40 CFR §270.11.

I.F. CONFIDENTIAL INFORMATION

The Permittee may claim confidential any information required to be submitted by this permit in accordance with 40 CFR §270.12.

I.G. DEFINITIONS

For purposes of this permit, terms used herein shall have the same meaning as those in RCRA and 40 CFR Parts 124, 260, 261, 264, and 270, unless this permit specifically provides otherwise; where terms are not defined in the regulation, the permit, or EPA guidances or publications, the meaning associated with such terms shall be defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term.

I.G.1. The term "solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

I.G.2. A "hazardous constituent" for purposes of this permit are those substances listed in 40 CFR Part 261 Appendix VIII.

I.G.3. A "solid waste management unit" for the purposes of this permit includes any unit which has been used for the treatment, storage,

or disposal of solid waste at any time, irrespective of whether the unit is or ever was intended for the management of solid waste. RCRA regulated hazardous waste management units are also solid waste management units.

I.G.4. A "unit" for the purposes of this permit includes, but is not limited to, any landfill, surface impoundment, waste pile, land treatment unit, incinerator, injection well, tank, container storage area, septic tank, drain field, wastewater treatment unit, elementary neutralization unit, transfer station, or recycling unit.

I.G.5. A "release" for purposes of this permit includes any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of any hazardous waste or hazardous constituents.

I.G.6. "Contamination" for purposes of this permit refers to the presence of any hazardous constituent in a concentration which exceeds the naturally occurring concentration of that constituent in the immediate vicinity of the facility (in areas not affected by the facility).

I.G.7. "Corrective action," for purposes of this permit, may include all corrective measures necessary to protect human health and the environment for all releases of hazardous waste or hazardous constituents from any solid waste management unit at the facility, regardless of the time at which waste was placed in the unit, as required under 40 CFR §264.101. Corrective measures may address releases to air, soils, surface water or groundwater.

II.A. Applicability

The Conditions of this Part apply to:

II.A.1. The solid waste management units identified in Appendix A.

II.A.2. Any additional solid waste management units or releases of hazardous waste or hazardous constituents other than those identified in Appendix A, discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means.

II.B. RCRA Facility Assessment (RFA)

II.B.1. The Permittee shall notify the Regional Administrator of any additional solid waste management unit(s) or releases of hazardous constituents or hazardous waste not identified in Appendix A, or Condition II.A.1., discovered during the course of groundwater monitoring, field investigations, environmental audits or other means within fifteen (15) days of discovery.

II.B.2. The Permittee shall prepare a RCRA Facility Assessment (RFA) plan and a proposed schedule of implementation and completion for any additional solid waste management unit(s) or release(s) which is discovered subsequent to the issuance of this permit. The plan shall include methods and specific actions as necessary to determine whether a prior or continuing release of hazardous waste or hazardous constituents has occurred at each solid waste management unit. The plan must also include, at a minimum, the following information for each unit:

(1) Location of unit(s) on a topographic map of appropriate scale such as required under §270.14(b)(19).
(2) Designation of type and function of unit(s).
(3) General dimensions, capacities and structural description of unit(s) (supply any available plans/drawings).
(4) Dates that the unit(s) was operated.
(5) Specification of all wastes that have been managed at/in the unit(s).
(6) All available information pertaining to any release of hazardous waste or hazardous constituents from such unit(s) (to include groundwater data, soil analyses, and/or surface water data).
(7) Results of sampling and analysis of groundwater, landsurface and subsurface strata, surface water or air requested by the Regional Administrator.

II.C. RCRA Facility Investigation (RFI)

II.C.1. The Permittee shall prepare a RCRA Facility Investigation (RFI) Plan for those units identified in Appendix A as needing an RFI, which includes schedules of implementation and completion of specific actions necessary to determine the nature and extent of releases and the potential pathways of contaminant releases to the air, land, surface water, and groundwater. The Permittee must provide sufficient justification and/or documentation that a release is not probable if a media/pathway associated with a unit (groundwater, surface water, soil or air) is not included in the RFI plan. Such deletions of a media or pathway from the RFI are subject to the approval of the Regional Administrator.

II.C.2. The Permittee shall prepare a RCRA Facility Investigation (RFI) Plan for those units identified under Condition II.B. which includes schedules of implementation and completion of specific actions necessary to determine the nature and extent of releases indicated by the assessment, and the potential pathways of contaminant releases to the air, land, surface water, and groundwater. The Permittee must provide sufficient justification and/or documentation that a release is not probable if a unit identified under Condition II.B. or a media/pathway associated with such unit (groundwater, surface water, soil or air) is not included in the RFI plan. Such deletions of a unit, media or pathway from the RFI are subject to the approval of the Regional Administrator.

II.C.3. The RFI Plan shall meet the requirements of Appendix B at a minimum. The RFI shall be conducted in accordance with the approved RFI Plan and Appendix B. The Permittee shall provide written sufficient justification for any omissions or deviations from the minimum requirements of Appendix B. Such omissions or deviations are subject to the approval of the Regional Administrator. The scope of the RFI plan shall include all investigations necessary to ensure compliance with §264.101(c).

II.D. Interim Measures

II.D.1 The Permittee may conduct interim measures to contain, remove or treat contamination resulting from the release of hazardous constituents from a solid waste management unit in order to protect public health and the environment upon approval by the Regional Administrator. Such interim measures may be conducted concurrently with investigations required under the terms of this permit.

II.D.2. The Permittee shall notify the Regional Administrator of any proposed interim/corrective measures at least thirty (30) days prior to implementation. The notice shall include a description and a schedule of implementation of any proposed interim measures.

II.D.3. The Permittee shall give notice to the Regional Adminstrator as soon as possible of any planned changes, reduction or additions to the interim measures.

II.D.4. Final approval of interim measures as corrective action required under §264.101 shall be in accordance with 40 CFR §270.41 and Condition II.E.2. as a permit modification.

II.E. Corrective Action

II.E.1. Corrective action must be instituted by the Permittee under an approved plan as necessary to protect public health and the environment for all releases of hazardous waste or hazardous constituents from any solid waste management unit at the facility, regardless of the time at which waste was placed in such unit or whether such unit was originally intended for management of solid waste.

II.E.2. The Regional Administrator shall review the final RFI report required under Condition II.F. and notify the Permittee of the need for further investigative actions and/or the need for a corrective action study and/or plan to meet the requirements of §264.101.

II.E.3. Upon determination by the Regional Administrator that a corrective action study and/or plan is needed, the permit shall be modified pursuant to 40 CFR §270.41 to address such requirements. The modification shall identify the solid waste management unit(s) and associated releases requiring corrective action plans and/or studies; specify requirements for development, submission and implementation of such plans/studies; specify requirements for financial assurances for completion of corrective action as required under 40 CFR §264.101(b); and include other HSWA requirements as appropriate.

II.E.4. The Permittee must implement corrective actions beyond the facility boundary, where necessary to protect human health and the environment, unless the permittee demonstrates to the satisfaction of the Regional Administrator that, despite the permittee's best efforts, the permittee was unable to obtain the necessary permission to undertake such actions. The permittee is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. Assurances of financial responsibility for completion of such off-site corrective action will be required.

II.F. Reporting Requirements

II.F.1. RFA Report

The Permittee shall submit a RCRA Facility Assessment Report of the results of the RFA required under Condition II.B. in accordance

with the schedule(s) under Condition II.G. The RFA Report must include at a minimum the information listed under Condition II.B.2. and other appropriate information necessary to determine the need for a RFI under Condition II.C.2.

II.F.2. RFI Report

The Permittee shall submit a Draft and Final RCRA Facility Investigation Report. The RFI Reports shall be submitted in accordance with the schedule(s) under Condition II.G.5.

The RFI Report shall include an analysis and summary of all required investigations of solid waste management units and their results. The summary shall include a report on the type and extent of contamination at the facility, including sources and migration pathways, and a description of actual or potential receptors. The report shall also describe the extent of contamination (qualitative/ quantitative) in relation to background levels indicative for the area. The objective of this task shall be to ensure that the investigation data are sufficient in quality (e. g., quality assurance procedures have been followed) and quantity to describe the nature and extent of contamination, potential threat to human health and/or the environment, and to support a Corrective Action Study and/or Plan, if necessary.

II.F.3. Interim Measure Report

Upon completion of Interim Measures conducted under Condition II.D. the Permittee shall submit a report to EPA that contains:

a. A description of measure(s) implemented;

b. Summaries of results;

c. Summaries of all problems encountered;

d. Summaries of accomplishments and/or effectiveness of interim measure; and

e. Copies of all relevant laboratory/ monitoring data, etc. in accordance with Condition I.D.9.

II.F.4. Progress Reports

II.F.4.i. RFA/RFI Progress Reports

If the time required to conduct the RFI or RFA is greater than 180 days, the Permittee shall provide the EPA with quarterly progress reports (90 day intervals) beginning ninety (90) days from implementation of the approved plan containing:

a. A description of the portion of the RFA/RFI completed;

b. Summaries of findings;

c. Summaries of all deviations from the approved RFA/RFI Plan during the reporting period;

d. Summaries of all problems or potential problems encountered during the reporting period;

e. Projected work for the next reporting period; and

f. Copies of daily reports, inspection reports, laboratory/monitoring data, etc.

II.F.4.ii. Interim Measures Progress Reports

If the time required for completion of an Interim Measure is greater than 180 days, the Permittee shall provide EPA with quarterly progress reports (90 day intervals) beginning ninety (90) days after initiation of the Interim Measure(s). Such reports shall include:

a. A description of the portion of the Interim Measure completed;

b. Summaries of all deviations from the Interim Measures Plan during the reporting period;

c. Summaries of all problems or potential problems encountered during the reporting period;

d. Projected work for the next reporting period; and

e. Copies of laboratory/monitoring data.

II.F.5. Imminent Hazard Reports

II.F.5.i. The Permittee shall report any imminent or existing hazard to public health or the environment from any release of hazardous waste or hazardous constituents from a solid waste management unit to the Regional Administrator. Any such information shall be reported orally within 24 hours from such time the Permittee becomes aware of the circumstances. This report shall include the information specified under Conditions I.D.14.a. and b.

II.F.5.ii. A written report shall also be provided to the Regional Administrator within fifteen (15) days of the time the Permittee becomes aware of the circumstances. The written report shall contain the information specified under Conditions I.D.14.a. and b.; a description of the release and its cause; the period of the release; whether the release has been stopped; and if not,

the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the release.

II.F.6. All reports must be signed and certified in accordance with 40 CFR §270.11.

II.F.7. Three (3) copies of all reports/plans shall be provided by the Permittee to U.S. EPA at the following address:

Mr. James H. Scarbrough, P.E.
Chief, RCRA Branch
Waste Management Division

Environmental Protection Agency
Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30365

II.G. Schedules of Compliance

II.G.1. The Permittee shall submit the RFA Plan(s) for solid waste management units or releases discovered after the effective date of this permit required under Condition II.B.2. to the Regional Administrator within sixty (60) days of the notification required under Condition II.B.1.

II.G.2. The Permittee shall submit the RFA Report required under Condition II.F.1. within thirty (30) of completion of the approved RFA Plan.

II.G.3. The Permittee shall submit the RFI Plan required by Condition II.C.1. and the associated documentation to the Regional Administrator within 120 days of the effective date of this permit.

II.G.4. The Permittee shall submit the RFI Plan(s) required under Condition II.C.2. for solid waste management units or releases discovered after the effective date of this permit within ninety (90) days of submission of the RFA report required under Condition II.F.

II.G.5. The Permittee shall submit the Draft RFI Report required under Condition II.F. to EPA for review ninety (90) days after completion of the RFI. The Final RFI Report shall be submitted to EPA within thirty (30) days of receipt of EPA comments on the Draft RFI Report.

II.G.6. All plans and schedules shall be subject to approval by the Regional Administrator prior to implementation. The Permittee shall revise all submittals and schedules as specified by the Regional Administrator. Upon approval the Permittee shall implement all plans and schedules as written.

II.G.7. The results of all plans and reports shall be submitted in accordance with the approved schedule. Extensions of the due date for submittals may be granted by the Regional Administrator based on the Permittee's demonstration that sufficient justification for the extension exists.

II.G.8. If the Permittee at any time determines that the RFA or RFI plans required under Conditions II.B. or II.C. no longer satisfy the requirements of §264.101 or this permit for prior or continuing releases of hazardous waste or hazardous constituents from solid waste management units, he must submit an amended plan(s) to the Regional Administrator within ninety (90) days of such determination.

WASTE MINIMIZATION CERTIFICATION

Until certification of closure the Permittee shall be required to certify no less often than annually that the Permittee has a program in place to reduce the volume and toxicity of hazardous waste that he generates to the degree determined by the Permittee to be economically practicable and the proposed method of treatment, storage or disposal is that practicable method currently available to the Permittee which minimizes the present and future threat to human health and the environment.

The Permittee shall maintain copies of the certification in the facility operating record as required under 40 CFR §264.73(b)(9).

Part IV - LAND DISPOSAL RESTRICTIONS

40 CFR Part 268 identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may continue to be placed on or in a land treatment, storage or disposal unit. The Permittee shall maintain compliance with the requirements of this Part. Where the Permittee has applied for an extention, waiver or variance under this Part the Permittee shall comply with all restrictions on land disposal under this Part once the effective date for the waste has been reached pending final approval of such application.

Facility Submission Summary

A summary of the planned reporting requirements contained in the RCRA SWMU Permit is presented below:

Facility Submission Requirements	Due Date
RFI Workplan for SWMU(s) identified at time of permit issuance in Condition II.A.1.	120 days after effective date of permit
Progress Reports on RFI (and interim measures as appropriate)	Quarterly, beginning 90 days from implementation of RFI plan*
Draft RFI Report	Ninety (90) days after RFI completion
Final RFI Report	Thirty (30) days after receipt of EPA comments on Draft RFI Report
Corrective Action Plan	Upon notification from Regional Administrator

The above reports must be signed and certified in accordance with 40 CFR §270.11.

*This applies to RFI plans that are for more than 180 days.

I.D. NUMBER NCD000604322 DATE ISSUED: June 30, 1988

PERMIT NO. NCD000604322

HAZARDOUS WASTE MANAGEMENT PERMIT

Permittee The Singer Furniture Company
Post Office Box 1588
Lenoir, North Carolina 28645

Pursuant to the 10 NCAC 10F North Carolina Hazardous Waste Management Rules, a permit is issued to the Singer Furniture Company, hazardous waste storage/treatment facility located in Lenoir, Caldwell County on 904 Virginia Street, SW, at latitude 35° 53' 45" and longitude 081° 33' 00".

The Permittee must comply with all terms and conditions of the permit. This permit consists of the conditions discussed in Parts I, II, III, IV, V, VI, VII, and VIII, the applicable regulations contained in 40 CFR Parts 260 through 264 and 270 and 124 [as adopted in 10 NCAC (North Carolina Administrative Code) 10F .0029-.0037] and statutory requirements of N.C.G.S. 130A - Article 9 (Solid Waste Management Act as amended) and the attached Application. Applicable regulations are those which are in effect on the date of issuance of this permit [40 CFR 270.32(c) as adopted in 10 NCAC 10F .0034] and are attached. This permit is based on the assumption that the information submitted in the permit application and as modified by subsequent amendments (hereafter referred to as the application) is accurate and that the facility will be operated as specified in the application. Any inaccuracies found in this information could lead to the termination or modification of this permit and potential enforcement action [40 CFR 270.41, 270.42, and 270.43 as adopted in 10 NCAC 10F .0034]. The Permittee shall inform the North Carolina Department of Human Resources of any deviation from or changes in the information in the application which would affect the Permittee's ability to comply with the applicable regulations or permit conditions.

This permit is effective as of July 30, 1988, and shall remain in effect until July 30, 1998, unless revoked and reissued, or terminated [40 CFR 270.50 as adopted in 10 NCAC 10F .0034] or continued in accordance with NCAC.

Jerome H. Rhodes, Head
Hazardous Waste Branch
Solid Waste Management Section

William F. Hamer, Supervisor
Hazardous Waste Permitting

8169-1-28
DHS Form 2871 (Rev.4/88)

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ATTACHMENT

Singer Furniture Company Application
(as declared complete on May 11, 1988)

Part A	Part A Application
Part B	Facility Description
Part C	Waste Characteristics
Part D	Process Information
Part F	Procedures to Prevent Hazards
Part G	Contingency Plan
Part H	Personnel Training
Part I	Closure Plans
Part J	Other Federal Laws
Part K	Certification
Appendix A	Waste Characterization
Appendix B	Inspection Log Sheets and Miscellaneous Forms
Appendix C	Spill Prevention, Control & Countermeasures Plan
Appendix D	Coordination Agreements
Appendix E	Financial Assurance
Appendix F	Compliance History
Appendix G	Drawings
Appendix H	Solid & Hazardous Waste Management Branch Correspondence
Appendix I	EPA Method 2 Test Procedures EPA Method 5 Test Procedures

PART I - STANDARD CONDITIONS

A. EFFECT OF PERMIT

The Permittee is allowed to store, treat or dispose of hazardous waste in accordance with the conditions of this permit. Any storage, treatment, or disposal of hazardous waste not authorized in this permit is prohibited. Compliance with this permit constitutes compliance, for purposes of enforcement, with the N.C. Hazardous Waste Management Rules (10 NCAC 10F) and N.C.G.S. 130A - Article 9 (Solid Waste Management Act as amended). Issuance of this permit does not convey property rights of any sort or any exclusive privilege; nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of State or local law or regulations. Compliance with the terms of this permit does not constitute a defense to any action brought under any law governing protection of public health or the environment for any imminent and substantial endangerment to human health or the environment.

B. PERMIT ACTIONS

This permit may be modified, revoked and reissued, or terminated for cause as specified in 40 CFR 270.41, 270.42, and 270.43 as adopted in 10 NCAC 10F .0034. The filing of a request for a permit modification, revocation and reissuance, or termination or the notification of planned changes or anticipated noncompliance on the part of the Permittee does not stay the applicability or enforceability of any permit condition.

C. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

D. DUTIES AND REQUIREMENTS

1. Duty to Comply. The Permittee shall comply with all conditions of this permit, except to the extent and for the duration such noncompliance is authorized by an emergency permit issued under 40 CFR 270.61 as adopted in 10 NCAC 10F .0034. Any permit noncompliance constitutes a violation of N. C. Hazardous Waste Management Rules and N.C.G.S. 130A - Article 9 (Solid Waste Management Act as amended) and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or for denial of a permit renewal application.

2. Duty to Reapply. If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must submit a complete application for a new permit at least 180 days before this permit expires.

3. Permit Expiration. This permit and all conditions therein will remain in effect beyond the permit's expiration date and until a decision is made concerning issuance of a new permit if the Permittee has submitted a timely, complete application (see 40 CFR 270.14-270.29 and 270.10 as adopted in 10 NCAC 10F .0034) and through no fault of the Permittee, the Secretary of the Department of Human Resources or his designee has not issued a new permit as set forth in 40 CFR 124.15 as adopted in 10 NCAC 10F .0035.

4. Need to Halt or Reduce Activity Not a Defense. It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

5. Duty to Mitigate. The Permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.

6. Proper Operation and Maintenance. The Permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxillary facility or similar systems only when necessary to achieve compliance with the conditions of the permit.

7. Duty to Provide Information. The Permittee shall furnish to the Secretary of the Department of Human Resources or his designee, within a reasonable time, any relevant information which the Secretary of the Department of Human Resources or his designee may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The Permittee shall also furnish to the Secretary of the Department of Human Resources or his designee, upon request, copies of records required to be kept by this permit.

8. Inspection and Entry. The Permittee shall allow the Secretary of the Department of Human Resources, or an authorized representative, upon the presentation of credentials and other documents as may be required by law to:

   a) Enter at reasonable times upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

   b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c) Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d) Sample or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the N. C. Hazardous Waste Management Rules, any substances or parameters at any location.

9. Monitoring and Records.

a) Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The method used to obtain a representative sample of the waste to be analyzed must be the appropriate method from Appendix I of 40 CFR Part 261 as adopted in 10 NCAC 10F .0029 and Appendix A of the attachment. Laboratory methods must be those specified on page C-12 and in Appendix A of the attachment.

b) The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports and records required by this permit, and records of all data used to complete the application for this permit for a period of at least three (3) years from the date of the sample, measurement, report or record. These periods may be extended by request of the Secretary of the Department of Human Resources or his designee at any time and are automatically extended during the course of any unresolved enforcement action regarding this facility.

c) Records of monitoring information shall include:

(1) The date, exact place, and time of sampling or measurements;

(2) The individual(s) who performed the sampling or measurements;

(3) The date(s) analyses were performed;

(4) The individual(s) who performed the analyses;

(5) The analytical techniques or methods used; and

(6) The results of such analyses.

d) The Permittee shall retain all results of the required annual waste analysis in order to document the incinerator's continued exemption described in Part V of this permit. The

analysis of Singer's waste must show a phthalate concentration of less than 100 ppm each year to maintain this exemption.

10. Reporting Planned Changes. The Permittee shall give notice to the Secretary of the Department of Human Resources or his designee as soon as possible of any planned physical alterations or additions to the permitted facility.

11. Anticipated Noncompliance. The Permittee shall give advance notice to the Secretary of the Department of Human Resources or his designee of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

12. Transfer of Permits. This permit may be transferred to a new owner or operator only if it is modified or revoked and reissued pursuant to 40 CFR 270.41 and 270.42 as adopted in 10 NCAC 10F .0034. Before transferring ownership or operation of the facility during its operating life, the Permittee shall notify the new owner or operator in writing of the requirements of 40 CFR 264 as adopted in 10 NCAC 10F .0032 and 40 CFR 270 as adopted in 10 NCAC 10F .0034.

13. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date listed below:

    a) Preliminary design drawings of the tank and conveyor belt assembly within thirty (30) days of the effective date of this permit;

    b) Construction completed within ninety (90) days of approval of tank system design drawings;

    c) Progress reports submitted monthly during 90-day construction period;

    d) As-built blueprints submitted within thirty (30) days prior to placing hazardous waste in the tank;

    e) A written assessment of the tank's structural integrity and an independent professional engineer's certification that the tank was built per approved design drawings submitted within thirty (30) days prior to placing hazardous waste in the tank;

    f) Documentation submitted within thirty (30) days prior to placing hazardous waste in the tank verifying that the employees' training program includes the management of the tank.

14. Twenty-four Hour Reporting. The Permittee shall report to the Secretary of the Department of Human Resources or his designee any noncompliance which may endanger health or the environment. Any information shall be provided verbally within 24 hours from the time the Permittee becomes aware of the circumstances. The following shall be included as information which must be reported verbally within 24 hours:

a) Information concerning release of any hazardous waste that may cause an endangerment to public drinking water supplies.

b) Any information of a release or discharge of hazardous waste, or of a fire or explosion from the facility, which could threaten the environment or human health outside the facility. The description of the occurrence and its cause shall include:

(1) Name, address, and telephone number of the owner or operator.
(2) Name, address, and telephone number of the facility.
(3) Date, time, and type of incident.
(4) Name and quantity of material(s) involved.
(5) The extent of injuries, if any.
(6) An assessment of actual or potential hazard to the environment and human health outside the facility, where this is applicable.
(7) Estimated quantity and disposition of recovered material that resulted from the incident.

A written submission shall also be provided within five (5) days of the time the Permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the periods of noncompliance (including exact dates and times), and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The Permittee need not comply with the five-day written notice requirement if the Secretary of the Department of Human Resources or his designee waives that requirement and the Permittee submits a written report within fifteen (15) days of the time the Permittee becomes aware of the circumstances.

15. Other Noncompliance. The Permittee shall report all other instances of noncompliance not otherwise required to be reported at the time monitoring reports are submitted. The reports shall contain the information listed in Condition I.D.14.

16. Other Information. When the Permittee becomes aware that he failed to submit any relevant facts in the permit application, or submitted incorrect information in a permit application or in any report to the Secretary of the Department of Human Resources or his designee, the Permittee shall promptly submit such facts or information.

E. SIGNATORY REQUIREMENTS

All reports or other information requested by the Secretary of the Department of Human Resources or his designee shall be signed and certified according to 40 CFR 270.11 as adopted in 10 NCAC 10F .0034.

F. DOCUMENTS TO BE MAINTAINED AT FACILITY SITE

The Permittee shall maintain at the facility, until closure is completed and certified by an independent registered professional engineer, the following documents and amendments, revisions and modifications to these documents:

1. Waste analysis plan submitted in accordance with 40 CFR 264.13 as adopted in 10 NCAC 10F .0032 and pages C-10 through C-12 and Appendix A of the attachment.

2. Personnel training documents and records submitted in accordance with 40 CFR 264.16(d) as adopted in 10 NCAC 10F .0032 and pages H-1 through H-21 and Appendix B of the attachment.

3. Contingency plan submitted in accordance with 40 CFR 264.53(a) as adopted in 10 NCAC 10F .0032 and pages G-1 through G-45 and Appendix C of the attachment.

4. Closure plan submitted in accordance with 40 CFR 264.112(a) as adopted in 10 NCAC 10F .0032 and pages I-1 through I-13 and Appendix E of the attachment.

5. Cost estimate for facility closure submitted in accordance with 40 CFR 264.142(d) as adopted in 10 NCAC 10F .0032 and Section I-4 on page I-8 of the attachment.

6. Operating record required by 40 CFR 264.73 as adopted in 10 NCAC 10F .0032, and pages C-11, F-4 through F-7, F-15 through F-20, G-37 through G-39, H-21, Appendix B of the attachment and Condition I.D.9. of this permit.

7. Inspection schedules developed in accordance with 40 CFR 264.15(b) as adopted in 10 NCAC 10F .0032 and pages F-4 through F-7, F-15 through F-20 and Appendix B of the attachment.

All amendments, revisions and modifications to any plan or cost estimates required by this permit shall be submitted to the Secretary of the Department of Human Resources or his designee for approval and permit modification.

G. ANNUAL REPORT

The Permittee shall prepare and submit an annual report by March 1 of each year in accordance with 10 NCAC 10F .0037. The report shall include, in accordance with 40 CFR 264.75 as adopted in 10 NCAC 10F .0032, the following information for facility activities during the previous calendar year:

1. The EPA identification number, name, and address of the facility;

2. The calendar year covered by the report;

3. For off-site facilities, the EPA identification number of each hazardous waste generator from which the facility received a hazardous waste during the year; for imported shipments, the report must give the name and address of the foreign generator;

4. A description and the quantity of each hazardous waste the facility received during the year; [for off-site facilities, this information must be listed by EPA identification number of each generator]

5. The method of treatment, storage, or disposal of each hazardous waste;

6. The most recent closure cost estimate under 40 CFR 264.142 as adopted in 10 NCAC 10F .0032; and

7. The certification signed by the owner or operator of the facility or his authorized representative.

H. MANIFEST SYSTEM

1. The Permittee shall utilize the manifest system when receiving hazardous waste from off-site in accordance with 40 CFR 264.71 as adopted in 10 NCAC 10F .0032 unless the Permittee submits an unmanifested waste report in accordance with 40 CFR 264.76 as adopted in 10 NCAC 10F .0032.

2. The Permittee shall report any manifest discrepancies in accordance with 40 CFR 264.72 as adopted in 10 NCAC 10F .0032.

I. DOCUMENTS TO BE SUBMITTED PRIOR TO OPERATION

1. Within thirty (30) days after the effective date of this permit, Singer must submit preliminary design drawings of the tank and conveyor belt assembly. Any other relevant information concerning the tank and its installation must also be submitted at this time.

2. Within ninety (90) days after approval of the tank system design, Singer must complete construction and installation of the tank and conveyor belt assembly.

3. Progress reports must be submitted every month during the tank construction period.

4. Within thirty (30) days prior to placing hazardous waste in the tank, Singer must submit as-built blueprints of the tank and conveyor belt assembly with an independent professional engineer's certification that the system was built to meet the approved design specifications. At this time, a written assessment of the tank's structural integrity must also be submitted.

5. Within thirty (30) days prior to placing hazardous waste in the tank, Singer must submit documentation verifying that the training program for employees includes the use and management of the new tank.

J. CONFIDENTIAL INFORMATION

The Permittee may claim confidential any information required to be submitted by this permit in accordance with 40 CFR 270.12 as adopted in 10 NCAC 10F .0034.

K. DEFINITIONS

For purposes of this Permit, terms used herein shall have the same meaning as those of 40 CFR Parts 124, 260, 261, 264, and 270, unless this Permit specifically provides otherwise; where terms are not defined in the regulations, the Permit, applicable EPA guidance documents or publications, the meaning associated with such terms shall be defined by a standard dictionary reference or the generally accepted scientific or industrial meaning of the term.

1. "Hazardous constituents" for the purposes of this permit are those substances listed in 40 CFR Part 261 Appendix VIII and include hazardous constituents released from solid waste and hazardous constituents that are reaction by-products.

2. "Solid Waste Management Unit" for the purposes of this Permit include any unit which contains or has contained solid waste at any time irrespective of whether the unit is or ever was intended for the management of solid waste.

3. "Release" for the purposes of this Permit includes any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of any hazardous waste or hazardous constituents.

4. "Contamination" for the purposes of this Permit refers to the presence of any hazardous constituent in a concentration which exceeds the naturally occurring concentration of that constituent in the immediate vicinity of the facility (in areas not affected by the facility).

5. "Corrective action" for prior or continuing releases from solid waste management units for the purposes of the Permit may include "corrective action" as provided for in 40 CFR 264.100 and other remedial actions for any environmental media as deemed appropriate by the Secretary of the Department of Human Resources or his designee to protect public health or the environment.

6. The term "solid waste" means, garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, agricultural operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under §402 of the Federal Water Pollution Control Act, as amended (86 Stat. 880), or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended (68 Stat. 923).

PART II - GENERAL FACILITY CONDITIONS

A. Authorized Waste. The Permittee is authorized to store, treat and incinerate the following hazardous waste(s) or categories of hazardous waste in accordance with the conditions specified in this permit:

D001 Lacquer dust as defined in 40 CFR 261.21 as adopted in 10 NCAC 10F .0029 and described on pages C-2, C-3 and C-8 of the attachment.

D001 Filler scrapings as defined in 40 CFR 261.21 as adopted in 10 NCAC 10F .0029 and described on pages C-2, C-3 and C-7 of the attachment.

D001 Discarded rags containing filler scraping residue as defined in 40 CFR 261.21 as adopted in 10 NCAC 10F .0029 and described on pages C-2 and C-3 of the attachment.

These wastes may be stored in containers, treated in a tank and incinerated as specified on page A-3 of the attachment. Hazardous waste container storage specifications are described on pages D-2 through D-5 of the attachment and Part III of this permit. The treatment tank specifications are described on pages D-6 through D-7 of the attachment and Part IV of this permit. The tank must meet all requirements of the compliance schedules specified in Condition IV.B. before operation can commence. Incinerator specifications and limitations are described on pages D-10 through D-18 of the attachment and Part V of this permit. The Permittee qualifies for the incinerator exemption as per 40 CFR 264.340(b) as adopted in NCAC 10F .0032, thereby incinerating the above wastes solely on the basis of ignitability.

B. Design and Operation of Facility. The Permittee shall maintain and operate the facility to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste constituents to air, soil or surface water which could threaten human health or the environment.

C. Receipt of Off-Site Wastes. The Permittee is authorized to receive hazardous wastes from other Singer plants only. The Permittee must immediately return all waste received from any generator not described on page D-4 of the attachment.

D. General Waste Analysis. The Permittee shall follow the procedures described in the waste analysis plan as indicated on pages C-10 through C-12 and Appendix A of the attachment. Parameters and test methods used shall be those described on page C-12 of the attachment. Sampling methods used shall be those described in Appendix A of the attachment. Results of these analyses shall be maintained as per 40 CFR 264.13 as adopted in 10 NCAC 10F .0032 and as identified in Condition I.D.9.

The Permittee shall verify his waste analysis as part of the quality assurance program. The quality assurance program will be in accordance

with current EPA practices or equivalent methods approved by the Secretary of the Department of Human Resources or his designee, and at a minimum ensure that the Permittee maintains proper functional instruments, uses approved sampling and analytical methods, assures the validity of sampling and analytical procedures, and performs correct calculations.

E. Annual Waste Analysis. The Permittee shall analyze all waste streams at a minimum of once per year to ensure compliance with the incinerator exemption described in Condition I.D.9. and Part V of this permit. Singer's waste stream must exhibit a phthalate concentration of less than 100 ppm to maintain this exemption. This annual analysis must include, at a minimum, all the parameters listed on Table C-II on page C-12 of the attachment.

F. Security. The Permittee shall comply with the security provisions of 40 CFR 264.14(b) and (c) as adopted in 10 NCAC 10F .0032 and pages F-2 and F-3 of the attachment.

G. General Inspection Requirements. The Permittee shall follow the inspection schedule as described on pages F-4 through F-7, F-15 through F-20 and Appendix B of the attachment and shall comply with 40 CFR 264.15 (c) and (d) as adopted in 10 NCAC 10F .0032.

H. Personnel Training. The Permittee shall conduct personnel training in accordance with 40 CFR 264.16 as adopted in 10 NCAC 10F .0032 and as described on pages H-1 through H-21 and Appendix B of the attachment.

I. General Requirements for Ignitable, Reactive, or Incompatible Waste. The Permittee shall comply with the requirements of 40 CFR 264.17(a) and (c) as adopted in 10 NCAC 10F .0032.

J. Required Equipment. The Permittee shall equip the facility and make readily available to operating personnel the necessary equipment to carry out the contingency plan, as described on pages G-28 through G-30 and G-41 through G-44 of the attachment. At all times, the equipment requirement described in 40 CFR 264.32, as adopted in 10 NCAC 10F .0032 shall be met.

K. Testing and Maintenance of Equipment. The Permittee shall test and maintain the equipment specified in the previous permit condition and as identified on pages F-4 through F-7 and Appendix B of the attachment as necessary to ensure its proper operation in time of emergency.

L. Access to Communications or Alarm System. The Permittee shall maintain access to the communications or alarm system as required by 40 CFR 264.34 as adopted in 10 NCAC 10F .0032.

M. Contingency Plan.

1. Implementation of Plan. The Permittee shall immediately carry out the provisions of the contingency plan whenever there is a fire,

explosion, or release of hazardous waste or constituents which threatens or could threaten human health or the environment as required by 40 CFR 264.56 as adopted in 10 NCAC 10F .0032. All or part of the contingency plan shall be implemented for both major and minor incidents.

2. Copies of Plan. The Permittee shall comply with the requirements of 40 CFR 264.53 as adopted in 10 NCAC 10F .0032.

3. Amendments to Plan. The Permittee shall review and immediately amend, if necessary, the contingency plan, in accordance with 40 CFR 264.54 as adopted in 10 NCAC 10F .0032. Singer must submit notification and an amended contingency plan thirty (30) days prior to Plant #33 closure.

4. Emergency Coordinator. The Permittee shall comply with the requirements of 40 CFR 264.55 as adopted in 10 NCAC 10F .0032, concerning the emergency coordinator.

N. Manifest System. The Permittee shall comply with the manifest requirements of 40 CFR 264.71, 264.72, and 264.76 as adopted in 10 NCAC 10F .0032.

O. Recordkeeping and Reporting.

1. Operating Record. The Permittee shall maintain a written operating record at the facility in accordance with 40 CFR 264.73(a), (b)(1), (2), (3), (4), (5), (6), (7) (off-site only), (8), and (9) as adopted in 10 NCAC 10F .0032, and as described on pages C-11, F-4 through F-7, F-15 through F-20, G-37 through G-39, H-21, Appendix B of the attachment and Condition I.D.9. of this permit.

2. Annual Report. The Permittee shall comply with the annual report requirements of 40 CFR 264.75 as adopted in 10 NCAC 10F .0032 and 10 NCAC 10F .0037.

P. Closure.

1. Performance Standard. The Permittee shall close the facility in accordance with the closure plan as described on pages I-1 through I-6 of the attachment and as required in 40 CFR 264.111 as adopted in 10 NCAC 10F .0032. The Permittee shall also conduct soil sampling at the drum storage area down to the top of the "C" horizon.

2. Amendment to Closure Plan. The Permittee shall amend the closure plan in accordance with 40 CFR 264.112(b) as adopted in 10 NCAC 10F .0032 whenever necessary.

3. Notification of Closure. The Permittee shall notify the Secretary of the Department of Human Resources or his designee at least forty-five (45) days prior to the date he expects to begin closure.

4. Time Allowed For Closure. Within 90 days after receiving the final volume of hazardous waste, the Permittee shall treat or remove from site all hazardous waste in accordance with the schedule specified in the closure plan. After receiving the final volume of hazardous waste, the Permittee shall complete closure activities in accordance with the schedule specified in the closure plan on page I-5 and Figure I-1 of the attachment.

5. Disposal or Decontamination of Equipment. The Permittee shall comply with the requirements of 40 CFR 264.114 as adopted in 10 NCAC 10F .0032. All equipment shall be emptied prior to decontamination. After steam-cleaning, the rinsate shall be collected and analyzed. Singer must submit all analysis results.

6. Certification of Closure. The Permittee shall certify that the facility has been closed in accordance with the specifications in the closure plan as required by 40 CFR 264.115 as adopted in 10 NCAC 10F .0032. The Permittee shall also submit a certification from an independent professional engineer verifying that the facility was closed per the specifications of the closure plan as described on pages I-1 through I-6 of the attachment and Conditions III.I., IV.E. and V.D.

Q. Cost Estimate for Facility Closure. The Permittee shall comply with the requirements of 40 CFR 264.142 as adopted in 10 NCAC 10F .0032, including the requirements to adjust and revise the cost estimates, when necessary. The Permittee's approximate closure cost estimate is described on page I-8 of the attachment.

R. Financial Assurance for Facility Closure. The Permittee shall demonstrate continuous compliance with 40 CFR 264.143 as adopted in 10 NCAC 10F .0032, or where applicable with 40 CFR 264.146, 264.149, 264.150, and 264.151 as adopted in 10 NCAC 10F .0032 by providing documentation of financial assurance in at least the amount of the cost estimates required by permit Condition II.Q. and page I-8 of the attachment.

The financial mechanism used shall be that instrument specified on page I-9 and Appendix E of the attachment. The Permittee may propose using a different mechanism by submitting a new financial instrument to the Secretary of the Department of Human Resources or his designee for approval. The Permittee must submit this documentation no later than sixty (60) days prior to the effective date of the proposed change. The existing financial mechanism shall remain in force until the change is approved.

S. Liability Requirements. The Permittee shall comply with the requirements of 40 CFR 264.147 as adopted in 10 NCAC 10F .0032, including the requirements to have and maintain liability coverage for sudden and accidental occurrences in the amount of at least $1 million per occurrence with an annual aggregate of at least $2 million, exclusive of legal defense costs.

The financial mechanism used shall be that instrument specified on page I-11, I-12 and Appendix E of the attachment. The Permittee may propose

using a different mechanism by submitting a new financial instrument to the Secretary of the Department of Human Resources or his designee for approval. The Permittee must submit this documentation no later than sixty (60) days prior to the effective date of the proposed change. The existing financial mechanism shall remain in force until the change is approved.

T. Incapacity of Owners or Operators, Guarantors, or Financial Institutions.

The Permittee shall comply with 40 CFR 264.148 as adopted in 10 NCAC 10F .0032 whenever necessary.

U. Cost Estimate for Completion of Correction Action.

1. The Permittee shall prepare a cost estimate for the completion of any corrective action required under this permit for solid waste management units in order to provide financial assurance for completion of corrective action as required under 40 CFR 264.101(b). Such cost estimate will be based upon the cost of operation, inspection, monitoring, and maintenance of the corrective action system to meet the requirements of 40 CFR 264.101 and this permit.

2. The Permittee shall submit a cost estimate for any additional corrective action for prior or continuing releases on the date specified by the Secretary of the Department of Human Resources or his designee.

V. Financial Assurance for Corrective Action.

1. The Permittee shall demonstrate continuous compliance with 40 CFR 264.101 by providing documentation of financial assurance using a mechanism specified in 40 CFR 264.151 in at least the amount of the cost estimate required under Condition II.U. The words "completion of corrective action" shall be substituted for "closure and/or post-closure" as appropriate in the financial mechanism.

2. The Permittee shall submit financial assurance for completion of corrective action as required under 40 CFR 264.101 no later than thirty (30) days prior to beginning full operation of the approved corrective action.

W. Special Conditions.

1. When a discrepancy exists between the wording of an item in the Application and this permit, the permit requirements take precedence over the Application.

2. Where a discrepancy exists between the RCRA Facility Assessment (RFA) report (attached as part of this Permit) and this permit as to the future requirements to be taken at the facility, the permit requirements take precedence over the requirements reflected in the report.

PART III - STORAGE IN CONTAINERS

The container storage area is located outdoors as shown on Figure F-1011-11-S-006 of the attachment. The dimensions of the storage area are approximately 40' x 35'. A fence forms the northern boundary, while recessed landscape timbers form the eastern and western boundaries.

All drums containing waste materials shall be stored on pallets. Pallets may be stacked two (2) high; however, no more than four (4) drums may be stored on any one pallet. Typical aisle spacing shall be per Drawing No. F-1011-11-S-007 of the attachment, but in no case less than three (3) feet.

Only solid wastes may be stored in this area. Maximum inventory of this area shall be 500 drums. The hazardous wastes that may be stored in this area include D001 (lacquer dust), D001 (filler scrapings), and D001 (discarded rags) as described in Condition II.A. of this permit. At time of closure, soil sampling of the storage area shall be conducted as specified on pages I-4a and I-4b of the attachment and Condition III.I. of this permit.

A. Condition of Containers. If a container holding hazardous waste is not in good condition (e.g., severe rusting, apparent structural defects) or if it begins to leak, the Permittee shall transfer the hazardous waste from such container to a container that is in good condition or manage the waste in some other way that complies with the requirements of this permit.

B. Compatibility of Waste with Containers. The Permittee shall comply with 40 CFR 264.172 as adopted in 10 NCAC 10F .0032 and ensure that the ability of the container to contain the waste is not impaired.

C. Management of Containers. The Permittee shall manage containers in accordance with 40 CFR 264.173 as adopted in 10 NCAC 10F .0032 and as described on pages D-2 through D-5 of the attachment. The Permittee shall also comply with 40 CFR 264.175(c)(2) as adopted in 10 NCAC 10F .0032. All hazardous waste storage containers shall be on pallets to prevent contact from any accumulated liquid. No more than four (4) drums shall be stored on any pallet.

D. Inspections. The Permittee shall inspect container storage areas in accordance with 40 CFR 264.174 as adopted in 10 NCAC 10F .0032 and as described on pages F-5, F-18 and Appendix B of the attachment.

E. Aisle Space. At a minimum, the Permittee shall maintain aisle space as required by 40 CFR 264.35 as adopted in 10 NCAC 10F .0032. Minimum aisle space for the container storage area shall be three (3) feet.

F. Special Requirements for Ignitable or Reactive Waste. The Permittee shall not locate containers holding ignitable or reactive waste within 15 meters (50 feet) of the facility's property line.

G. Special Requirements for Incompatible Waste.

1. The Permittee shall not place incompatible wastes in the same container.

2. The Permittee shall not place hazardous waste in an unwashed container that previously held an incompatible waste or material.

3. The Permittee shall not store a container of hazardous waste that is incompatible with any waste or material stored nearby in other containers, piles, open tanks or surface impoundments unless the container is separated from the other materials by a dike, berm, wall, or other device.

H. Receipt of Containers. The Permittee shall receive the shipment of drummed waste material as described on page D-3 of the attachment; however, a minimum of 10% of the drums shall be fingerprinted as described on page D-3 of the attachment. Any unacceptable wastes discovered during this inspection shall be immediately returned to the generator.

I. Closure. The Permittee shall follow the closure plan as described on pages I-2 through I-13 of the attachment and shall comply with 40 CFR 264.178 as adopted in 10 NCAC 10F .0032. At a minimum, soil sampling at time of closure shall include samples taken down to the top of the "C" horizon. Singer must submit a certification from an independent professional engineer verifying that closure was completed to the specifications of this Condition of the permit.

PART IV - TREATMENT IN TANKS

The Singer facility shall use one portable treatment tank for mixing waste to be loaded into the incinerator. This tank shall be located inside the incinerator building on the impermeable, diked concrete floor.

The tank shall be an approximately 4' x 6' x 4' deep, V-shaped metal hopper attached to a 2' wide "live-bottom" rubber belt conveyor. The tank shall be used to mix D001 (lacquer dust), D001 (filler scrapings), D001 (discarded rags), and damp sawdust. After mixing is completed, the waste shall leave the tank, via the conveyor belt, to be loaded into the incinerator.

Since the tank shall never contain free liquids and is situated in a building with an impermeable floor, this facility is exempted from the requirements of 40 CFR 264.193 as adopted in 10 NCAC 10F .0032.

A. Design of Tanks. The Permittee shall maintain all tanks in accordance with pages D-6 and D-7 of the attachment and the approved information to be submitted after the effective date of the permit. This information includes preliminary design drawings of the tank and conveyor belt, as-built blueprints of the tank and conveyor belt, an assessment of the tank's integrity, a certification from an independent professional engineer that the tank and belt assembly were constructed per the approved plans and documentation that the management of the tank system has been added to the employee training program.

B. Reporting Requirements. Within thirty (30) days after the effective date of this permit, Singer must submit preliminary design drawings of the tank and other relevant information concerning the tank and its installation. Within ninety (90) days after approval of the tank system design, Singer must complete construction and installation of the tank and conveyor belt assembly. Progress reports on the tank construction must be submitted every month during this 90-day period. Within thirty (30) days prior to placing hazardous waste in the treatment tank, Singer must submit as-built blueprints of the tank and conveyor belt assembly with an independent professional engineer certification that the unit was built to meet or exceed the minimum design specifications as described on pages D-6 and D-7 of the attachment and as shown on the approved design drawings submitted in accordance with Condition IV.A. Within thirty (30) days prior to placing hazardous waste in the tank, Singer must submit documentation that the employees' training program includes the use and management of the tank.

C. General Operating Requirements.

1. The Permittee shall comply with 40 CFR 264.192(a) as adopted in 10 NCAC 10F .0032. A written assessment of the tank's structural integrity must be submitted thirty (30) days prior to placing hazardous waste in the tank.

2. The Permittee shall comply with 40 CFR 264.192(b) as adopted in 10 NCAC 10F .0032. An independent, qualified, registered professional

engineer must inspect and certify the integrity of the tank and submit this certification thirty (30) days prior to placing hazardous waste in the tank.

3. The Permittee shall comply with 40 CFR 264.192(e) as adopted in 10 NCAC 10F .0032. The conveyor belt assembly must be supported and protected against physical damage and excessive stress.

4. The Permittee shall comply with 40 CFR 264.192 (g) as adopted in 10 NCAC 10F .0032. The Permittee shall obtain and keep on file at the facility the written statements by those persons required to certify the design and installation of the tank system.

5. The Permittee shall comply with 40 CFR 264.194 as adopted in 10 NCAC 10F .0032 and as described on pages D-6 and D-7 of the attachment.

6. The Permittee must completely empty the tank before washing the tank out as described on page D-7 of the attachment.

D. Inspections. The Permittee shall comply with inspection requirements set forth in 40 CFR 264.195 (b)(1) and (3), and (d) as adopted in 10 NCAC 10F .0032 and as described on pages F-5, F-17 and Appendix B of the attachment.

E. Closure. The Permittee shall follow the closure plan as described on pages I-2 through I-5 of the attachment and shall comply with 40 CFR 264.197 as adopted in 10 NCAC 10F .0032. The tank shall be empty before decontamination. Both the tank and the conveyor belt assembly shall be steam-cleaned and the rinsate collected for analysis. Singer must submit the results of the analyses with a certification from an independent professional engineer verifying the closure plan was followed per this Condition of the permit.

F. Special Requirements for Ignitable or Reactive Wastes.

1. The Permittee shall comply with 40 CFR 264.198(a) as adopted in 10 NCAC 10F .0032.

2. The Permittee shall comply with the requirements of 40 CFR 264.198(b) as adopted in 10 NCAC 10F .0032.

G. Special Requirements for Incompatible Wastes.

1. The Permittee shall not place incompatible wastes in the same tank.

2. The Permittee shall not place hazardous waste in an unwashed tank which previously held an incompatible waste or material.

PART V - INCINERATION

This facility qualifies for the automatic exemption allowed under 40 CFR 264.340(b) as adopted in NCAC 10F .0032 and may incinerate the wastes D001 (lacquer dust), D001 (filler scrapings), and D001 (discarded rags), which are listed solely because of ignitability. This exemption is documented in the facility's administrative record and on page D-10 and Appendix A of the attachment.

A. The Permittee shall operate and maintain the incinerator as described on pages D-10 through D-18 of the attachment.

B. The Permittee shall inspect the incinerator and supporting structures and equipment as per 40 CFR 264.347(b) and Condition II.G. of this permit.

C. The Permittee shall adhere to the waste analysis plan as per 40 CFR 264.341 and Condition II.D. of this permit.

D. The Permittee shall adhere to the closure plan conditions as per 40 CFR 264.351 and Condition II.P. of this permit. The incinerator and concrete pad must be steam-cleaned and the rinsate collected for analysis after decontamination. Singer must submit the results of the analyses with a certification from an independent professional engineer verifying the closure plan was completed per this Condition of the permit.

PART VI - SOLID WASTE MANAGEMENT UNITS

A. Applicability.

The Conditions of this Part apply to:

1. The solid waste management units identified in Appendix A.

2. Any additional solid waste management units or releases of hazardous waste or hazardous constituents other than those identified in Appendix A, discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means.

B. RCRA Facility Assessment (RFA).

1. The Permittee shall notify the Secretary of the Department of Human Resources or his designee of any additional solid waste management unit(s) or releases of hazardous constituents or hazardous waste not identified in Appendix A, discovered during the course of groundwater monitoring, field investigations, environmental audits or other means within fifteen (15) days of discovery.

2. The Permittee shall prepare a RCRA Facility Assessment (RFA) plan and a proposed schedule of implementation and completion for any additional solid waste management unit(s) or release(s) which are discovered subsequent to the issuance of this permit. The plan shall include methods and specific actions as necessary to determine whether a prior or continuing release of hazardous waste or hazardous constituents has occurred at each solid waste management unit. The plan must also include, at a minimum, the following information for each unit:

   a) Location of unit(s) on a topographic map of appropriate scale such as required under §270.14(b)(19).
   b) Designation of type and function of unit(s).
   c) General dimensions, capacities and structural description of unit(s) (supply any available plans/drawings).
   d) Dates that the unit(s) was operated.
   e) Specification of all wastes that have been managed at/in the unit(s).
   f) All available information pertaining to any release of hazardous waste or hazardous constituents from such unit(s) (to include groundwater data, soil analyses, and/or surface water data).
   g) Results of sampling and analysis of groundwater, landsurface and subsurface strata, surface water or air requested by the Secretary of the Department of Human Resources or his designee.

C. RCRA Facility Investigation (RFI).

1. The Permittee shall prepare a RCRA Facility Investigation (RFI) Plan for those units identified in Appendix A as needing an RFI, which includes schedules of implementation and completion of specific actions necessary to determine the nature and extent of releases and the potential pathways of contaminant releases to the air, land,

surface water, and groundwater. The Permittee must provide sufficient justification and/or documentation that a release is not probable if a media/pathway associated with a unit (groundwater, surface water, soil or air) is not included in the RFI plan. Such deletions of a media or pathway from the RFI are subject to the approval of the Secretary of the Department of Human Resources or his designee.

2. The Permittee shall prepare a RCRA Facility Investigation (RFI) Plan for those units identified under Condition VI.B. which includes schedules of implementation and completion of specific actions necessary to determine the nature and extent of releases indicated by the assessment, and the potential pathways of contaminant releases to the air, land, surface water, and groundwater. The Permittee must provide sufficient justification and/or documentation that a release is not probable if a unit identified under Condition VI.B. or a media/pathway associated with such unit (groundwater, surface water, soil or air) is not included in the RFI plan. Such deletions of a unit, media or pathway from the RFI are subject to approval of the Secretary of the Department of Human Resources or his designee.

3. The RFI Plan shall meet the requirements of Appendix B at a minimum. The RFI shall be conducted in accordance with the approved RFI Plan and Appendix B. The Permittee shall provide written sufficient justification for any omissions or deviations from the minimum requirements of Appendix B. Such omissions or deviations are subject to the approval of the Secretary of the Department of Human Resources or his designee. The scope of the RFI plan shall include all investigations necessary to ensure compliance with §264.101(c).

D. Interim Measures.

1. The Permittee may conduct interim measures to contain, remove or treat contamination resulting from the release of hazardous constituents from a solid waste management unit in order to protect public health and the environment upon approval by the Secretary of the Department of Human Resources or his designee. Such interim measures may be conducted concurrently with investigations required under the terms of this permit.

2. The Permittee shall notify the Secretary of the Department of Human Resources or his designee of any proposed interim/corrective measures at least thirty (30) days prior to implementation. The notice shall include a description and schedule of implementation of any proposed interim measures.

3. The Permittee shall give notice to the Secretary of the Department of Human Resources or his designee as soon as possible of any planned changes, reduction or additions to the interim measures.

4. Final approval of interim measures as corrective action required under §264.101 shall be in accordance with 40 CFR 270.41 and Condition VI.E.2. as a permit modification.

E. Corrective Action.

1. Corrective action must be instituted by the Permittee under an approved plan as necessary to protect public health and the environment for all releases of hazardous waste or hazardous constituents from any solid waste management unit at the facility, regardless of the time at which waste was placed in such unit or whether such unit was originally intended for management of solid waste.

2. The Secretary of the Department of Human Resources or his designee shall review the final RFI report required under Condition VI.F. and notify the Permittee of the need for further investigative actions and/or the need for a correction action study and/or plan to meet the requirements of §264.101.

3. Upon determination by the Secretary of the Department of Human Resources or his designee that a corrective action study and/or plan is needed, the permit shall be modified pursuant to 40 CFR 270.41 to address such requirements. The modification shall identify the solid waste management unit(s) and associated releases requiring corrective action plans and/or studies; specify requirements for development, submission and implementation of such plans/studies; specify requirements for financial assurances for completion of corrective action as required under 40 CFR 264.101(b); and include other HSWA requirements as appropriate.

4. The Permittee must implement corrective actions beyond the facility boundary, where necessary to protect human health and the environment, unless the Permittee demonstrates to the satisfaction of the Secretary of the Department of Human Resources or his designee that, despite the Permittee's best efforts, the Permittee was unable to obtain the necessary permission to undertake such actions. The Permittee is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. Assurances of financial responsibility for completion of such off-site corrective action will be required.

F. Reporting Requirements.

1. RFA Report

The Permittee shall submit a RCRA Facility Assessment Report of the results of the RFA required under Condition VI.B. in accordance with the schedule(s) under Condition VI.G. The RFA Report must include at a minimum the information listed under Condition VI.B.2. and other appropriate information necessary to determine the need for a RFI under Condition VI.C.2.

2. RFI Report

The Permittee shall submit a Draft and Final RCRA Facility Investigation Report. The RFI Reports shall be submitted in accordance with the schedule(s) under Condition VI.G.5.

The RFI Report shall include an analysis and summary of all required investigations of solid waste management units and their results. The summary shall include a report on the type and extent of contamination at the facility, including sources and migration pathways, and a description of actual or potential receptors. The report shall also describe the extent of contamination (qualitative/quantitative) in relation to background levels indicative for the area. The objective of this task shall be to ensure that the investigation data are sufficient in quality (e.g., quality assurance procedures have been followed) and quantity to describe the nature and extent of contamination, potential threat to human health and/or the environment, and to support a Corrective Action Study and/or Plan, if necessary.

3. Interim Measure Report

Upon completion of Interim Measures conducted under Condition VI.D., the Permittee shall submit a report to this office that contains:

a) A description of measure(s) implemented;

b) Summaries of results;

c) Summaries of all problems encountered;

d) Summaries of accomplishments and/or effectiveness of interim measure; and

e) Copies of all relevant laboratory/monitoring data, etc. in accordance with Condition I.D.9.

4. Progress Reports

a) RFA/RFI Progress Reports

If the time required to conduct the RFI or RFA is greater than 80 days, the Permittee shall provide this office with quarterly progress reports (90 day intervals) beginning ninety (90) days from implementation of the approved plan containing:

(1) A description of the portion of the RFA/RFI completed;

(2) Summaries of findings;

(3) Summaries of all deviations from the approved RFA/RFI during the reporting period;

(4) Summaries of all problems or potential problems encountered during the reporting period;

(5) Projected work for the next reporting period; and

(6) Copies of daily reports, inspection reports, laboratory/monitoring data, etc.

b) Interim Measures Progress Reports

If the time required for completion of an Interim Measure is greater than 180 days, the Permittee shall provide this office with quarterly progress reports (90 day intervals) beginning ninety (90) days after initiation of the Interim Measure(s). Such reports shall include:

(1) A description of the portion of the Interim Measure completed;

(2) Summaries of all deviations from the Interim Measure Plan during the reporting period;

(3) Summaries of all problems or potential problems encountered during the reporting period;

(4) Projected work for the next reporting period; and

(5) Copies of laboratory/monitoring data.

5. Imminent Hazard Reports

a) The Permittee shall report any imminent or existing hazard to public health or the environment from any release of hazardous waste or hazardous constituents from a solid waste management unit to the Secretary of the Department of Human Resources or his designee. Any such information shall be reported orally within twenty-four (24) hours from such time the Permittee becomes aware of the circumstances. This report shall include the information specified under Condition I.D.14.

b) A written report shall also be provided to the Secretary of the Department of Human Resources or his designee within fifteen (15) days of the time the Permittee becomes aware of the circumstances. The written report shall contain the information specified under Condition I.D.14; a description of the release and its cause; the period of the release; whether the release has been stopped; and if not, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the release.

6. All reports must be signed and certified in accordance with 40 CFR 270.11.

7. Three (3) copies of all reports/plans shall be provided by the Permittee to this office at the following address:

Mr. Jerome H. Rhodes, Head
Hazardous Waste Branch
306 North Wilmington Street, Room 213
Post Office Box 2091
Raleigh, North Carolina 27602-2091

G. Schedules of Compliance.

1. The Permittee shall submit the RFA Plan(s) for solid waste management units or releases discovered after the effective date of this permit required under Condition VI.B.2. to the Secretary of the Department of Human Resources or his designee within sixty (60) days of the notification required under Condition VI.B.1.

2. The Permittee shall submit the RFA Report required under Condition VI.F.1. within thirty (30) days of completion of the approved RFA Plan.

3. The Permittee shall submit the RFI Plan required by Condition VI.C.1. and the associated doccumentation to the Secretary of the Department of Human Resources or his designee within 120 days of the effective date of this permit.

4. The Permittee shall submit the RFI Plan(s) required under Condition VI.C.2. for solid waste management units or releases discovered after the effective date of this permit within ninety (90) days of submission of the RFA report required under Condition VI.F.

5. The Permittee shall submit the Draft RFI Report required under Condition VI.F. to EPA for review ninety (90) days after completion of the RFI. The Final RFI Report shall be submitted to this office within thirty (30) days of receipt of comments from this office and EPA on the Draft RFI Report.

6. All plans and schedules shall be subject to approval by the Secretary of the Department of Human Resources or his designee prior to implementation. The Permittee shall revise all submittals and schedules as specified by the Secretary of the Department of Human Resources or his designee. Upon approval the Permittee shall implement all plans and schedules as written.

7. The results of all plans and reports shall be submitted in accordance with the approved schedule. Extensions of the due date for submittals may be granted by the Secretary of the Department of Human Resources or his designee based on the Permittee's demonstration that sufficient justification for the extension exists.

8. If the Permittee at any time determines that the RFA or RFI plans required under Conditions VI.B. or VI.C. no longer satisfy the requirements of §264.101 or this permit for prior or continuing releases of hazardous waste or hazardous constituents from solid waste management units, he must submit an amended plan(s) to the Secretary of the Department of Human Resources or his designee within ninety (90) days of such determination.

PART VII - WASTE MINIMIZATION

The following condition is pursuant to 40 CFR 264.73(b)(9)

WASTE MINIMIZATION CERTIFICATION

The Permittee shall be required to certify, no less often than annually, that he has a program in place to reduce the volume and toxicity of hazardous waste that he generates to the degree determined by the Permittee to be economically practicable and the proposed method of treatment, storage or disposal is that practicable method currently available to the Permittee which minimizes the present and future threat to human health and the environment.

Part VIII - LAND DISPOSAL RESTRICTIONS

40 CFR Part 268 identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may continue to be placed on or in a land treatment, storage or disposal unit. The Permittee shall maintain compliance with the requirements of this Part. Where the Permittee has applied for an extension, waiver or variance under this Part the Permittee shall comply with all restrictions on land disposal under this Part once the effective date for the waste has been reached pending final approval of such application.

I. Units Requiring a RCRA Facility Investigation (RFI)

Old Landfill (SWMU No. 1)

Abandoned Drums by Lower Creek (SWMU No. 2)

Glue Wash Evaporation Pond (SWMU No. 3)

Hazardous Waste Storage Area (SWMU No. 6)

Spill at Oil Tank, Lumber Yard Bldg. (SWMU No. 9)

II. Units Requiring No Further Action

Water Wash Storage Tank (SWMU No. 5)

Floor Area, Lumber Yard Building (SWMU No. 8)

Waste Satellite Storage Area (SWMU No. 7)

III. Units Whose Releases would be covered by the State Permit

Incinerator (SWMU No. 4)

IV. Copy of the RCRA Facility Assessment

(attached for information purposes)

I. RFI WORKPLAN REQUIREMENTS

The Permittee shall prepare a RCRA Facility Investigation (RFI) workplan that meets the requirements of Part II of this document. This Attachment is provided as guidance for the development of the RFI workplan.

A. Project Management Plan

The Permittee shall prepare a Project Management Plan which will include a discussion of the technical approach, schedules, and personnel. The Project Management Plan will also include a description of qualifications of personnel performing or directing the RFI, including contractor personnel. This plan shall also document the overall management approach to the RCRA Facility Investigation.

B. Sampling and Analysis Plan

The Permittee shall prepare a plan to document all monitoring procedures: sampling, field measures and sample analysis performed during the investigation to characterize the environmental setting, source, and releases of hazardous constituents, so as to ensure that all information and data are valid and properly documented.

1. Sampling/Field Measurements

The sampling section of the Sampling and Analysis Plan shall be in accordance with Characterization of Hazardous Waste Sites A Methods Manual: Volume II. Available Sampling Methods, EPA-600/4-83-040, and at a minimum discuss:

a. Selecting appropriate sampling locations, depths, etc.;

b. Obtaining all necessary ancillary data;

c. Determining conditions under which sampling should be conducted;

e. Determining which media are to be sampled (e.g., groundwater, air, soil, sediment, etc.);

f. Determining which parameters are to be measured and where;

g. Selecting the frequency of sampling and length of sampling period;

h. Selecting the types of samples (e.g., composites vs. grabs) and number of samples to be collected.

i. Documenting field sampling operations and procedures, including;

i) Documentation of procedures for preparation of reagents or supplies which become an integral part of the sample (e.g., filters, preservatives, and absorbing reagents);

ii) Procedures and forms for recording the exact location and specific considerations associated with sample acquisition;

iii) Documentation of specific sample preservation method;

iv) Calibration of field instruments;

v) Submission of field-biased blanks, where appropriate;

vi) Potential interferences present at the facility;

vii) Construction materials and techniques, associated with monitoring wells and piezometers;

viii) Field equipment listing and sampling containers;

ix) Sampling order; and

x) Decontamination procedures.

J. Selecting appropriate sample containers;

K. Sampling preservation; and

i. Chain-of-custody, including:

i) Standardized field tracking reporting forms to establish sample custody in the field prior to shipment;and

ii) Pre-prepared sample labels containing all information necessary for effective sample tracking.

2. Sample Analysis

Sample Analysis shall be conducted in accordance with SW-846: "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods"

The sample analysis section of the Sampling and Analysis Plan shall specify the following:

a. Chain-of-custody procedures, including:

i) Identification of a responsible party to act as sampling custodian at the laboratory facility authorized to sign for incoming field samples, obtain documents of shipment, and verify the data entered onto the sample custody records;

ii) Provision for a laboratory sample custody log consisting of serially numbered standard lab-tracking report sheets; and

iii) Specification of laboratory sample custody procedures for sample handling, storage, and dispersement for analysis.

b. Sample storage;

c. Sample preparation methods;

d. Analytical procedures, including:

i) Scope and application of the procedure;

ii) Sample matrix;

iii) Potential interferences;

iv) Precision and accuracy of the methodology; and

v) Method detection limits.

e. Calibration procedures and frequency;

f. Data reduction, validation and reporting;

g. Internal quality control checks, laboratory performance and systems audits and frequency, including:

i) Method blank(s);

ii) Laboratory control sample(s);

iii) Calibration check samples(s);

iv) Replicate sample(s);

v) Matrix-spiked sample(s);

vi) Control charts;

vii) Surrogate samples;

viii) Zero and span gases; and

ix) Reagent quality control checks.

h. Preventive maintenance procedures and schedules;

i. Corrective action (for laboratory problems); and

j. Turnaround time.

C. Data Management Plan

The Permittee shall develop and initiate a Data Management Plan to document and track investigation data and results. This plan shall identify and

set up data documentation materials and procedures, project file requirements, and project-related progress reporting procedures and documents. The plan shall also provide the format to be used to present the raw data and conclusions of the investigation.

1. Data Record

The data record shall include the following:

a. Unique sample or field measurement code;

b. Sampling or field measurement location and sample or measurement type;

c. Sampling or field measurement raw data;

d. Laboratory analysis ID number;

e. Property or component measured; and

f. Result of analysis (e.g. concentration).

2. Tabular Displays

The following data shall be presented in tabular displays:

a. Unsorted (raw) data;

b. Results for each medium, or for each constituent monitored;

c. Data reduction for statistical analysis, as appropriate;

d. Sorting of data by potential stratification factors (e. g., location, soil layer, topography); and

e. Summary data

3. Graphical Displays

The following data shall be presented in graphical formats (e. g., bar graphs, line graphs, area or plan maps, isopleth plots, cross-sectional plots or transects, three dimensional graphs, etc.):

a. Display sampling location and sampling grid:

b. Indicate boundaries of sampling area, and area where more data are required;

c. Display geographical extent of contamination;

d. Illustrate changes in concentration in relation to distances from the source, time, depth or other parameters; and

e. Indicate features affecting intramedia transport and show potential receptors.

II. RCRA Facility Investigation (RFI) Requirements

RCRA Facility Investigation:

The Permittee shall conduct those investigations necessary to: characterize the facility (Environmental Setting); define the source (Source Characterization); define the degree and extent of release of hazardous constituents (Contamination Characterization); and identify actual or potential receptors.

The investigations should result in data of adequate technical content and quality to support the development and evaluation of the corrective action plan if necessary. The information contained in a RCRA Part B permit application and/or RCRA Section 3019 Exposure Information Report may be referenced as appropriate.

All sampling and analyses shall be conducted in accordance with the Sampling and Analysis Plan. All sampling locations shall be documented in a log and identified on a detailed site map.

A. Environmental Setting

The Permittee shall collect information to supplement and/or verify Part B information on the environmental setting at the facility. The Permittee shall characterize the following as they relate to identified sources, pathways and areas of releases of hazardous constituents from Solid Waste Management Units.

1. Hydrogeology

The Permittee shall conduct a program to evaluate hydrogeologic condition at the facility. This program shall provide the following information:

a. A description of the regional and facility specific geologic and hydrogeologic characteristics affecting ground-water flow beneath the facility, including:

i) Regional and facility specific stratigraphy: description of strata including strike and dip, identification of stratigraphic contacts:

ii) Structural geology: description of local and regional structura features (e. g., folding, faulting, tilting, jointing, etc.);

iii) Depositional history;

iv) Regional and facility specific ground-water flow patterns; and

v) Identification and characterization of areas and amounts of recharge and discharge.

b. An analysis of any topographic features that might influence the ground water flow system.

c. Based on field data, tests, and cores, a representative and accurate classification and description of the hydrogeologic units which may be part of the migration pathways at the facility (i. e., the aquifers and any intervening saturated and unsaturated units), including:

i) Hydraulic conductivity and porosity (total and effective);

ii) Lithology, grain size, sorting, degree of cementation;

iii) An interpretation of hydraulic interconnections between saturated zones; and

iv) The attenuation capacity and mechanisms of the natural earth materials (e. g., ion exchange capacity, organic carbon content, mineral content etc.).

e. Based on data obtained from groundwater monitoring wells and piezometers installed upgradient and downgradient of the potential contaminant source, a representative description of water level or fluid pressure monitoring including:

i) Water-level contour and/or potentiometric maps;

ii) Hydrologic cross sections showing vertical gradients;

iii) The flow system, including the vertical and horizontal components of flow; and

iv) Any temporal changes in hydraulic gradients, for example, due to tidal or seasonal influences.

f. A description of manmade influences that may affect the hydrology of the site, identifying:

i) Local water-supply and production wells with an approximate schedule of pumping; and

ii) Manmade hydraulic structures (pipelines, french drains, ditches, etc.).

2. Soils

The Permittee shall conduct a program to characterize the soil and rock units above the water table in the vicinity of contaminant release(s). Such characterization may include, but not be limited to, the following types of information as appropriate:

a. Surface soil distribution;
b. Soil profile, including ASTM classification of soils;
c. Transects of soil stratigraphy;
d. Hydraulic conductivity (saturated and unsaturated);
e. Relative permeability;
f. Bulk density;
g. Porosity;
h. Soil sorptive capacity;
i. Cation exchange capacity (CEC);
j. Soil organic content;
k. Soil pH;
l. Particle size distribution;
m. Depth of water table;
n. Moisture content;
o. Effect of stratification on unsaturated flow;
p. Infiltration;
q. Evapotranspiration;
r. Storage capacity;
s. Vertical flow rate; and
t. Mineral content.

3. Surface Water and Sediment

The Permittee shall conduct a program to characterize the surface water bodies in the vicinity of the facility. Such characterization may include, but not be limited to, the following activities and information:

a. Description of the temporal and permanent surface water bodies including:

   i) For lakes and estuaries: location, elevation, surface area, inflow, outflow, depth, temperature stratification, and volume;

   ii) For impoundments: location, elevation, surface area, depth, volume, freeboard, and construction and purpose;

   iii) For streams, ditches, and channels: location, elevation, flow, velocity, depth, width, seasonal fluctuations, flooding tendencies (i. e., 100 year event), discharge point(s), and general contents.

   iv) Drainage patterns; and

   v) Evapotranspiration.

b. Description of the chemistry of the natural surface water and sediments. This includes determining the pH, total dissolved solids, total suspended solids, biological oxygen demand, alkalinity, conductivity, dissolved oxygen profiles, nutrients (NH_3, NO_3^-/NO_2^-, PO^{-3}), chemical oxygen demand, total organic carbon, specific contaminant concentrations, etc.

c. Description of sediment characteristics including:

i) Deposition area;

ii) Thickness profile; and

iii) Physical and chemical parameters (e. g., grain size, density, organic carbon content, ion exchange capacity, pH, etc.)

4. Air

The Permittee shall provide information characterizing the climate in the vicinity of the facility. Such information may include, but not be limited to:

a. A description of the following parameters:

i) Annual and monthly rainfall averages;

ii) Monthly temperature averages and extremes;

iii) Wind speed and direction;

iv) Relative humidity/dew point;

v) Atmospheric pressure;

vi) Evaporation data;

vii) Development of inversions; and

viii) Climate extremes that have been know to occur in the vicinity of the facility, including frequency of occurrence. (i. e. Hurricanes)

b. A description of topographic and manmade features which affect air flow and emission patterns, including:

i) Ridges, hills or mountain areas;

ii) Canyons or valleys;

iii) Surface water bodies (e. g. rivers, lakes, bays, etc.);

iv) Buildings.

B. Source Characterization

For those sources from which releases of hazardous constituents have been detected the Permittee shall collect analytic data to completely characterize the wastes and the areas where wastes have been placed, to the degree that is possible without undue safety risks, including: type, quantity; physical form; disposition (containment or nature of deposits); and facility characteristics affecting release (e. g., facility security, and engineering barriers). This shall include quantification of the following specific characteristics, at each source area:

1. Unit/Disposal Area Characteristics:

   a. Location of unit/disposal area;
   b. Type of unit/disposal area;
   c. Design features;
   d. Operating practices (past and present)
   e. Period of operation;
   f. Age of unit/disposal area;
   g. General physical conditions; and
   h. Method used to close the unit/disposal area.

2. Waste Characteristics:

   a. Type of wastes placed in the unit;

      i) Hazardous classification (e. g., flammable, reactive, corrosive, oxidizing or reducing agent);
      ii) Quantity; and

      iii) Chemical composition.

   b. Physical and chemical characteristics such as;

      i) Physical form (solid, liquid, gas);

      ii) Physical description (e. g., powder, oily sludge);

      iii) Temperature;

      iv) pH;

      v) General chemical class (e. g., acid, base, solvent);

      vi) Molecular weight;

      vii) Density;

      viii) Boiling point;

      ix) Viscosity;

x) Solubility in water;

xi) Cohesiveness of the waste; and

xii) Vapor pressure.

c. Migration and dispersal characteristics of the waste such as;

i) Sorption capability;

ii) Biodegradability, bioconcentration, biotransformation;

iii) Photodegradation rates;

iv) Hydrolysis rates; and

v) Chemical transformations.

The Permittee shall document the procedures used in making the above determinations.

C. Characterization of Releases of Hazardous Constituents

The Permittee shall collect analytical data on groundwater, soils, surface water, sediment, and subsurface gas contamination in the vicinity of the facility in accordance with the sampling and analysis plan as required above. These data shall be sufficient to define the extent, origin, direction, and rate of movement of contamination. Data shall include time and location of sampling, media sampled, concentrations found, conditions during sampling, and the identity of the individuals performing the sampling and analysis. The Permittee shall address the following types of contamination at the facility:

1. Groundwater Contamination

The Permittee shall conduct a groundwater investigation to characterize any plumes of contamination detected at the facility. This investigation shall at a minimum provide the following information:

a. A description of the horizontal and vertical extent of any plume(s) of hazardous constituents originating from the facility;

b. The horizontal and vertical direction of contamination movement;

c. The velocity of contaminant movement;

d. The horizontal and vertical concentration profiles of hazardous constituents in the plume(s);

e. An evaluation of factors influencing the plume movement; and

f. An extrapolation of future contaminant movement.

The Permittee shall document the procedures used in making the above determinations (e. g., well design, well construction, geophysics, modeling, etc.).

2. Soil Contamination

The Permittee shall conduct an investigation to characterize the contamination of the soil and rock units above the saturated zone in the vicinity of any contaminant release. The investigation may include the following information:

a. A description of the vertical and horizontal extent of contamination;

b. A description of appropriate contaminant and soil chemical properties within the contaminant source area and plume. This may include contaminant solubility, speciation, adsorption, leachability, exchange capacity, biodegradability, hydrolysis, photolysis, oxidation and other factors that might affect contaminant migration and transformation;

c. Specific contaminant concentrations;
d. The velocity and direction of contamination movement; and

e. An extrapolation of future contaminant movement.

The Permittee shall document the procedures used in making the above determinations.

3. Surface Water and Sediment Contamination

The Permittee shall conduct a surface water investigation to characterize contamination in surface water bodies resulting from releases of hazardous constituents at the facility.

The investigation may include, but not be limited to, the following information:

a. A description of the horizontal and vertical extent of any plume(s) originating from the facility, and the extent of contamination in underlying sediments;

b. The horizontal and vertical direction of contaminant movement;

c. The contaminant velocity;

d. An evaluation of the physical, biological and chemical factors influencing contaminant movement;

e. An extrapolation of future contaminant movement; and

f. A description of the chemistry of the contaminated surface waters and sediments. This includes determining the pH, total dissolved solids, specific contaminant concentrations, etc.

4. Air Contamination

The Permittee shall conduct an investigation to characterize gaseous releases of hazardous constituents into the atmosphere or any structures or buildings. This investigation may provide the following information:

a. A description of the horizontal and vertical direction and velocity of contaminant movement;

b. The rate and amount of the release; and

c. The chemical and physical composition of the contaminants(s) released, including horizontal and vertical concentration profiles.

The Permittee shall document the procedures used in making the above determinations.

D. Potential Receptors

The Permittee shall collect data describing the human populations and environmental systems that are susceptible to contaminant exposure from the facility. Chemical analysis of biological samples and/or data on observable effects in ecosystems may also be obtained as appropriate. The following characteristics shall be identified:

1. Current local uses and planned future uses of groundwater:

a. Type of use (e. g., drinking water source: municipal or residential, agricultural, domestic/non-potable, and industrial); and

b. Location of ground water users, to include withdrawal and discharge wells, within one mile of the impacted area.

The above information should also indicate the aquifer or hydrogeologic unit used and/or impacted for each item.

2. Current local uses and planned future uses of surface waters directly impacted by the facility:

a. Domestic and municipal (e. g., potable and lawn/gardening watering);
b. Recreational (e. g. swimming, fishing);
c. Agricultural;
d. Industrial; and
e. Environmental (e. g., fish and wildlife propagation).

3. Human use of or access to the facility and adjacent lands, including but not limited to:

a. Recreation;
b. Hunting;
c. Residential;
d. Commercial; and
e. Relationship between population locations and prevailing wind direction.

4. A general description of the biota in surface water bodies on, adjacent to, or affected by the facility.

5. A general description of the ecology within and adjacent to the facility.

6. A general demographic profile of the people who use or have access to the facility and adjacent land, including, but not limited to: age; sex; and sensitive subgroups.

7. A description of any known or documented endangered or threatened species near the facility.

RECEIVED DEC 1 1988

State of North Carolina
Department of Natural Resources and Community Development
Mooresville Regional Office

James G. Martin, Governor
S. Thomas Rhodes, Secretary

Albert F. Hilton, Regional Manager

DIVISION OF ENVIRONMENTAL MANAGEMENT
November 30, 1988

Mr. Richard J. McDonald,
Loss Control Manager
Singer Furniture Company
P. O. Box 1588
Lenoir, N. C. 28645

Subject: Air Permit No. 1772R11
Singer Furniture Co.,
Plant No.33
Caldwell County, N. C.

Dear Mr. McDonald:

In order to correct an error in condition No. 3 of Air Permit No. 1772R10 and in accordance with your request dated November 21, 1988, and your completed application received October 25, 1988, we are forwarding herewith Permit No. 1772R11 to Singer Furniture Company, Lenoir, Caldwell County, North Carolina for the construction and operation of air pollution abatement facilities or emission sources.

If any parts, requirements, or limitations contained in this permit are unacceptable to you, you have the right to request an adjudicatory hearing within thirty (30) days following receipt of this permit, identifying the specific issues to be contended. This request must be in the form of a written petition, conforming to Chapter 150B of the North Carolina General Statutes, and filed with the Office of Administrative Hearings, Post Office Drawer 11666, Raleigh, North Carolina 27604. Unless such demand is made, this permit shall be final and binding.

This permit shall be effective from November 30, 1988, until March 31, 1993, is nontransferable to future owners and operators, and shall be subject to the conditions and limitations as specified therein.

Sincerely,

D. Rex Gleason

D. Rex Gleason, P.E.
Acting Regional Supervisor

Enclosures
cc: Mr. Ogden Gerald

919 North Main Street, P.O. Box 950, Mooresville, N.C. 28115-0950 • Telephone 704-663-1699

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NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION

DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT

DIVISION OF ENVIRONMENTAL MANAGEMENT

A I R P E R M I T N O. 1772R11

Issue Date: November 30, 1988 Effective Date: November 30, 1988

Expiration Date: March 31, 1993 Replaces Permit: 1772R10

To construct and operate air emission sources or air cleaning devices, and for the discharge of the associated air contaminants into the atmosphere. In accordance with the provisions of Article 21B of Chapter 143, General Statutes of North Carolina as amended, and other applicable Laws, Rules and Regulations,

PERMISSION IS HEREBY GRANTED TO

Singer Furniture Company
Plant No. 33
904 Virginia Street, Lenoir
Caldwell County, North Carolina

FOR THE

construction and operation of air emission sources or air cleaning devices and appurtenances consisting of:

1. a flat line finishing system utilizing nonphotochemically reactive or exempt solvents,

2. a primary burner (800,000 BTU per hour minimum) and a secondary burner (800,000 BTU per hour minimum) installed on a natural gas fired 500 pounds per hour, Type 0 and Type V waste, multiple chamber incinerator,

3. one closed-loop transfer cyclone, one veneer waste transfer cyclone (80 inches in diameter), and five baghouses (2300, 3825, 3060, 3060, and 3060 square feet of cloth area respectively) installed on the woodwaste collection system,

4. one multicyclone (24 nine-inch tubes) installed on a woodwaste/No. 2 through No. 5 oil fired boiler No. 1 (21 MBTU/hour maximum heat input),

5. one multicyclone (30 nine-inch tubes) installed on a woodwaste/No. 2 through No. 5 oil fired boiler No. 2 (21 MBTU/hour maximum heat input), and

6. nine paint spray booths (eight baffle-type and one dry filter type) installed on the furniture spray painting operation utilizing nonphotochemically reactive or exempt painting materials,

to be constructed and operated in accordance with the completed application received October 25, 1988, and in conformity with the plans, specifications, and other supporting data, all of which are filed with the Department of Natural Resources and Community Development and are incorporated as part of this Permit.

This Permit shall be subject to the following specified conditions and limitations including any testing, reporting, or monitoring requirements:

A. SPECIFIC CONDITIONS AND LIMITATIONS

1. The Permittee shall comply with applicable Environmental Management Commission Regulations, including 15 NCAC 2D .503, .0504, .0505, .0512, .0516, .0518, .0521, .0522, and .0535.

2. Sulfur dioxide emissions from the fuel burning equipment shall not exceed 2.3 pounds per million BTU heat input.

3. In no case shall the following emission limitations be exceeded:

Source	Pollutant	Emission Limit(s)
Boiler No. 1	Particulate	0.413 lb/MBTU (firing oil only)
	Particulate	0.508 lb/MBTU (firing wood only)
Boiler No. 2	Particulate	0.413 lb/MBTU (firing oil only)
	Particulate	0.508 lb/MBTU (firing wood only)

4. Visible emissions from the air emission sources installed after July 1, 1971 shall not be more than 20 percent opacity when averaged over a six-minute period, except that six-minute periods averaging not more than 87 percent opacity may occur not more than once in any hour nor more than four times in any 24-hour period.

5. Visible emissions from the air emission sources installed prior to July 1, 1971, shall not be more than 40 percent opacity when averaged over a six-minute period, except that six-minute periods averaging not more than 90 percent opacity may occur not more than once in any hour nor more than four times in any 24-hour period.

6. Volatile organic compound emissions that are photochemically reactive as defined in 15 NCAC 2D .0518(d) shall not exceed 40 pounds per calendar day from the entire plant site or facility.

7. The collected flyash shall not be reinjected into the boilers.

8. The Permittee shall take all reasonable precautions with any operation, process, handling, transportation, or storage facilities to prevent fugitive particulate emissions from becoming airborne.

9. As required by 15 NCAC 2D .0535, when particulate and/or visible emissions exceed Environmental Management Regulations for more than four hours the Regional Supervisor, Division of Environmental Management, Mooresville Region, (704) 663-1699 shall be notified as promptly as possible but in no case later than 24 hours of becoming aware of the occurrence. Such notice shall specify the facility name and location, the nature and cause of the excess emissions, the time when first observed, the expected duration, and the estimated rate of emissions. This reporting requirement does not allow the operation of the facility in excess of Environmental Management Commission Regulations.

B. GENERAL CONDITIONS AND LIMITATIONS

1. All reports, test data, monitoring data, notifications, and requests for renewal shall be submitted to the:

   Regional Supervisor
   North Carolina Division of Environmental Management
   919 N. Main Street
   Mooresville, N. C. 28115

2. Reports on the operation and maintenance of the facility shall be submitted by the Permittee to the Regional Supervisor, Division of Environmental Management at such intervals and in such form and detail as may be required by the Division. Information required in such reports may include, but is not limited to process weight rates, firing rates, hours of operation, and preventive maintenance schedules.

3. Any changes in the information submitted in the application regarding facility emissions, or any changes that modify equipment or processes of existing permitted facilities, or any changes in the quantity or quality of materials processed that will result in previously unpermitted, new, or increased emissions must be reported to the Regional Supervisor, Division of Environmental Management. If appropriate, modifications to the permit may then be made by the Division of Environmental Management to reflect any necessary changes in the permit conditions. In no case are any new or increased emissions allowed that will cause violation of the emission limitations specified herein.

4. This Permit is subject to revocation or modification by this Division upon a determination that information contained in the application or presented in support thereof is incorrect, conditions under which this Permit was granted have changed, or violations of conditions contained in this Permit have occurred. The facility shall be properly operated and maintained at all times in such a manner to effect an overall reduction in air pollution.

5. Under the statutory authority of G.S. 143-215.3 (a)(2), no person shall refuse entry or access to any authorized representative of the Division of Environmental Management who requests entry for purposes of inspection, and who presents appropriate credentials, nor shall any person obstruct, hamper, or interfere with any such representative while in the process of carrying out his official duties. Refusal of entry may constitute grounds for permit revocation and assessment of civil penalties.

6. This Permit is nontransferable by the Permittee. Future owners and operators must obtain a new air permit from the Division of Environmental Management.

7. This Permit does not relieve the Permittee of the responsibility of complying with all applicable requirements of any Federal, State, or Local water quality or land quality control authority.

8. The Permittee at least ninety (90) days prior to the expiration of this Permit shall request its extension by letter. The letter should include the permit number, the appropriate renewal fee, description of any modifications, and should be sent to the Regional Supervisor, Division of Environmental Management.

9. A violation of any term or condition of this Permit shall subject the Permittee to enforcement procedures contained in North Carolina General Statutes 143-215.114, including assessment of civil penalties.

Permit issued this the 30th day of November, 1988.

NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION

D. Rex Gleason, Acting Regional Supervisor
Division of Environmental Management
By Authority of the Environmental Management Commission

Air Permit No. 1772R11

Tickler 3/1/92

Pet 4 Environmental Air Pe...

State of North Carolina
Department of Natural Resources and Community Development
Mooresville Regional Office

James G. Martin, Governor
S. Thomas Rhodes, Secretary

Albert F. Hilton, Regional Manager

DIVISION OF ENVIRONMENTAL MANAGEMENT

July 28, 1987

Mr. Richard J. McDonald
Safety Engineering Manager
Singer Furniture Co.
P. O. Box 1588
Lenoir, N. C. 28645

Subject: Air Permit No. 6107
Singer Furniture Co.
Plant No. 4
Caldwell County, N. C.

Dear Mr. McDonald:

In accordance with your application received July 2, 1987, we are forwarding herewith Permit No. 6107 to Singer Furniture Company, Plant No. 4, Lenoir, Caldwell County, North Carolina for the construction and operation of air pollution abatement facilities or emission sources.

If any parts, requirements, or limitations contained in this permit are unacceptable to you, you have the right to request an adjudicatory hearing within thirty (30) days following receipt of this permit, identifying the specific issues to be contended. This request must be in the form of a written petition, conforming to Chapter 150B of the North Carolina General Statutes, and filed with the Office of Administrative Hearings, Post Office Drawer 11666, Raleigh, North Carolina 27604. Unless such demand is made, this permit shall be final and binding.

If you wish to have the hearing before a Hearing Officer with this Department, you must indicate in the petition that you waive the right to have the contested case conducted by a Hearing Officer in the Office of Administrative Hearings, and wish to have the matter conducted in the Department of Natural Resources and Community Development.

919 North Main Street, P.O. Box 950, Mooresville, N.C. 28115-0950 • Telephone 704-663-1699

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This permit shall be effective from July 28, 1987 until June 30, 1992, is nontransferable to future owners and operators, and shall be subject to the conditions and limitations as specified therein.

Sincerely,

Ronald L. McMillan

Ronald L. McMillan
Regional Supervisor

Enclosures

cc: Mr. Mike Sewell
Mr. Albert Hilton

NORTH CAROLINA

ENVIRONMENTAL MANAGEMENT COMMISSION

DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT

P E R M I T

To Construct and Operate, and
For the Discharge of Air Contaminants Into the Atmosphere

In accordance with the provisions of Article 21B of Chapter 143, General Statutes of North Carolina as amended, and other applicable Laws, Rules and Regulations,

PERMISSION IS HEREBY GRANTED TO

Singer Furniture Company
Plant No. 4
Lenoir, North Carolina

FOR THE

operation of a simple cyclone (7 feet in diameter) installed on a wood veneer hog to remove particulate and visible emissions, and for the discharge of the treated air into the outdoor atmosphere at its facility located at 914 Virginia Street, Lenoir, Caldwell County, North Carolina,

in accordance with the application received July 2, 1987, and in conformity with the plans, specifications, and other supporting data, all of which are filed with the Department of Natural Resources and Community Development and are incorporated as part of this Permit.

This Permit shall be effective from July 28, 1987 until June 30, 1992, is nontransferable to future owners and operators, and shall be subject to the following specified conditions and limitations:

1. The Permittee shall comply with applicable Environmental Management Regulations, including 15 NCAC 2D .0512, .0521, and .0535.

2. Reports on the operation and maintenance of the facility shall be submitted by the Permittee to the Division of Environmental Management at such intervals and in such form and detail as may be required by the Division. Information required in such reports may include, but is not limited to, process weight rates, firing rates, hours of operation, and preventive maintenance schedules.

3. As required by 15 NCAC 2D .0535, when particulate and/or visible emissions exceed Environmental Management Commission Regulations for more than four hours the Regional Supervisor, Mooresville Region, of the Division of Environmental Management shall be notified as promptly as possible but in no case later than 24 hours of becoming aware of the occurrence. Such notice shall specify the facility name and location, the nature and cause of the excess emissions, the time when first observed, the expected duration, and the estimated rate of emissions. This reporting requirement does not allow the operation of the facility in excess of Environmental Management Regulations.

4. The Permittee at least 90 days prior to the expiration of this Permit shall request its extension by letter. The letter should include the Permit number and a description of modifications, if any, that have been made.

5. This Permit is subject to revocation or modification upon a determination that information contained in the application or presented in support thereof is incorrect, conditions under which the Permit renewal was granted have changed, or violations of conditions contained in the Permit have occurred. The facility shall be properly operated and maintained at all times in such a manner to effect an overall reduction in air pollution.

6. A violation of any term or condition of this Permit shall subject the Permittee to enforcement procedures contained in North Carolina General Statutes 143-215.114, including assessment of civil penalties.

Permit issued this the 28th day of July, 1987.

NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION

Ronald L. McMillan

Ronald L. McMillan, Regional Supervisor
Division of Environmental Management
By Authority of the Environmental Management Commission

Permit No. 6107.

RCRA FACILITY ASSESSMENT
for the site of
Singer Furniture Company
Plant No. 33
Lenoir, North Carolina

RECEIVED
MAY 11 1988
SOLID WASTE MANAGEMENT SECTION

Prepared by Robert Reimer, WES, EPA IV

I. Preliminary Review

A. Facility Waste Generation and Manufacturing Process

Description

1. History

In the 1950's the City of Lenoir operated a public landfill on the northern portion of this site. (See RFA-Appendix No. 1 for a map.)

In 1963, the Kent Coffey Furniture Company purchased the site and built the main building of the current facility (the current Building No. 3). In 1969, the facility was purchased and operated by the Magnavox Company. Finally, in 1973, the site was purchased by the Singer Furniture Company. During this active industrial life, the facility has been used for the manufacture of home, electronic and occasional furniture. Hazardous wastes are generated during the manufacturing process in the form of finishing residues, contaminated rubbish (rags, etc.) and off-spec solvent materials. Singer built a hazardous waste incinerator on the site in 1980 for the destruction of its finishing residues.

2. Operations

The public landfill operated by the City of Lenoir was open to all and no records were kept as the the quantities or types of waste disposed of therein.

During the Kent Coffey period (1963 - 1969), the disposal site continued to be used privately, but now for only the basic types of waste typical to furniture manufacturing. This includes solid and liquid finishing residue, wood and metal scrap, solid glue waste and ordinary trash.

Magnavox continued to use the landfill in this manner during its ownership (1969 - 1973), as did Singer during its early years (1973 - 1976). In 1976, Singer began to send all finish residues and most other trash to the Caldwell County Landfill and Incinerator. Some wood and metal scrap continued to be put into the landfill until 1981 when it was closed, leveled and grassed over.

Since 1982, Singer has employed a consultant to investigate and monitor the status of the landfill and the local groundwater.

B. General Background on Environmental Setting

Refer to the Singer Furniture Part B application, Section B for more detailed information.

Surrounding property is all zoned "industrial." The site is bounded on the north by Lower Creek and an unnamed tributary to Lower Creek. While the facility's RCRA-regulated units are not within the 100-year floodplain, Lower Creek and its tributary are 100-year flood zones. Since the onsite landfill is adjacent to the two streams, portions of the landfill are affected by flooding. As recently as 1978, significant flooding has occurred in this area.

C. Locations and Characteristics of Solid Waste Management Units and Other Potential Areas of Concern

1. Facility Map Identifying Solid Waste Management Units

See RFA-Appendix No. 1 and No. 2 for maps of the SWMUs on site.

2. Solid Waste Management Unit Information

Old Landfill (SWMU No. 1)

a. Size and Location:
The landfill is roughly "L" shaped, but it has no clearly defined boundaries. It measures approximately 800' x 1000'. It is bounded by the Plant fence on the south and Lower Creek on the north. Wooded areas limit its expansion to the east and west.

b. Waste Characteristics:
The landfill operated as a public dump prior to 1963. After that time it received primarily furniture manufacturing residues and wastes. Liquids and solids were both disposed of in the landfill, including residues probably containing Appendix 8 contaminated wastes. No records, however, were kept on the placement of wastes in the landfill, nor can such data be generated by interviews, etc.

c. Migration Pathways:
Any leachate generated in the landfill could flow away in either the groundwater or via Lower Creek. The creek itself does not rise above the "wall" of the landfill in a 100 year flood, so leachate is generated only by rainfall and run-on from the adjacent plant area. No "leachate streams" were observed at the toe of the landfill, but it was not possible to examine the toe completely due to forest and vegetative overgrowth.

d. Evidence of a Release:
No evidence of a release was observed.

e. Potential of Exposure:
The potential of release and exposure is high. The landfill was not constructed according to modern hazardous waste standards, yet it contains unknown quantities of hazardous wastes. Only minimal monitoring for releases has been done to date.

Abandoned Drums by Lower Creek (SWMU No. 2)

a. Size and Location:
Between twelve (12) and twenty (20) fifty-five gallon drums were observed between the banks of Lower Creek and the north side of the landfill. These metal drums were rusted and their labels were worn off, apparently from years of weather exposure. They were scattered widely (rather than in any immediate proximity to each other). The Singer Company representative said that the drums floated onto the site during a prior flood event (probably in 1978).

b. Waste Characteristics:
The characteristics of the materials within the drums are unknown. For the most part the drums are rusted through and empty, although some contain liquid (possibly rain water). Labels are similarly illegible. If in fact the drums did "float" onto the facility, then they were probably only partially full.

c. Migration Pathways:
Any release from the drums would leave the facility boundaries via either the groundwater or Lower Creek. If the drums were mostly empty, then residues would leak slowly and enter the groundwater; the contents of full containers would either flow into or be washed into Lower Creek.

d. Evidence of a Release:
No evidence of a release was observed, in that no vegetation was visibly harmed and the contents of the drums was unknown. Clearly, however, if the drums contained any hazardous wastes at all then these wastes were released into the environment, since the drums can no longer contain waste.

e. Potential of Exposure:
Based on the low number of drums and the apparent age of them as well, there is a very low potential of exposure from the drums today. It is possible, however, that a plume of contamination exists in the groundwater as a result of a prior release.

Glue Wash Evaporation Pond (SWMU No. 3)

a. Size and Location:
Glue wash water from laminating operations is collected in drums and then poured into a depressed area behind Building No. 4, where it evaporates. The resulting "intermittent" pond is roughly circular and about twenty (20) feet across.

b. Waste Characteristics:
The liquid is mostly water. In the past, its glue component has contained one-half percent formaldehyde, and other Appendix 8 constituents could have been present. When the water and glue-volatiles evaporate, a thin crust of brownish white plastic-like material is left in place. This is periodically collected and disposed of as non-hazardous waste.

c. Migration Pathways:
It is unlikely that any significant air emissions occur from this pond. It is possible that any hazardous constituents (if present) could migrate away from the unit via the groundwater.

d. Evidence of a Release:
There is no evidence of a release of hazardous constituents from this unit.

e. Potential of Exposure:
The potential of exposure to hazardous constituents from this unit is minimal, given the small quantities involved. However, based on the historical composition of the glue and the length of time this practice has been occurring, there is a clear possibility of an non-sudden, uncontrolled release having occurred.

Incinerator (SWMU No. 4)

a. Size and Location:
The incinerator is described more completely in the RCRA Part B application for this facility. It is a single hearth, controlled combustion unit of relatively small size.

b. Waste Characteristics:
Finishing residues contaminated with solvents and paints (containing a very low level of hazardous constituents) are combusted along with stain wash water. The primary hazard associated with the finishing residues is their flammability.

c. Migration Pathways:
The only potential pathway is via air emissions and this release is controlled by the North Carolina RCRA permit.

d. Evidence of a Release:
No evidence of a release was observed.

e. Potential of Exposure:
Considering the very low levels of hazardous constituents present in the residues along with the efficiency of incineration in general, there is no significant potential of exposure from incinerator operations.

Water Wash Storage Tank (SWMU No. 5)

a. Size and Location:
The water wash storage tank is a vertical tank with a capacity of roughly 5,000 gallons. It feeds into the incinerator via a short pipeline.

b. Waste Characteristics:
The wash water contains stain and finishing rinses. These rinses may or may not contain hazardous constituents. A review of the historical data available would yield an answer.

c. Migration Pathways:
Possible releases from the tank would result from spills associated with either the tank itself or the tank-filling operations. Substantial spills could travel overland to the landfill area, but would not reach Lower Creek or its tributary directly. Therefore any actual releases would enter the environment via groundwater transport.

d. Evidence of a Release:
There is no evidence of a release from this unit.

e. Potential of Exposure:
The potential of exposure to hazardous constituents from this unit is very low.

Hazardous Waste Storage Area (SWMU No. 6)

a. Size and Location:
This is the area where drums of finishing residues are stored prior to incineration. It is located adjacent to the incinerator and measures about fifty (50) feet by fifty (50) feet.

b. Waste Characteristics:
The finishing residues are described under "Incinerator (SWMU No. 4)" above, and are much more extensively characterized in the facility's Part B application.

c. Migration Pathways:
The only route for migration at this unit would be for air-blown residues after a spill. The material is generally non-flowing and is easily contained (but for wind entrainment).

d. Evidence of a Release:
There was no evidence of a release visible, but the areas to the side and behind the storage pad were not inspected due to the difficulty of gaining access to those areas.

e. Potential of Exposure:
The potential for exposure exists due to the volume of material managed and the regular loading and unloading operations at this unit. (Residues are shipped onto this site by other Singer facilities.) Since the waste would be airborne, it could both travel far and be easily ingested or inhaled.

Waste Satellite Storage Area (SWMU No. 7)

a. Size and Location:
Finishing residues are stored at this unit prior to being relocated to the storage area near the incinerator. It is located inside the south fence near the maintenance building. It is about fifty (50) feet by twenty (20) feet.

b. Waste Characteristics:
The finishing residues are described under "Incinerator (SWMU No. 4)" above, and are much more extensively characterized in the facility's Part B application.

c. Migration Pathways:
The only route for migration at this unit would be for air-blown residues after a spill. The material is generally non-flowing and is easily contained (but for wind entrainment).

d. Evidence of a Release:
There was no evidence of a release visible, but the area behind the storage pad was not inspected due to the difficulty of gaining access to that area.

e. Potential of Exposure:
The potential for exposure is very low since wastes are not kept at this location very long prior to being moved to the regular storage area. Also since much of the total waste at this facility comes from offsite, the amount of waste managed at this unit is significantly less than at the regular storage area.

Floor Area, Lumber Yard Building (SWMU No. 8)
---

a. Size and Location:
The location of the Lumber Yard Building is given on the map in RFA-Appendix No.1. The building is open to the environment and is currently used for the storage of unused industrial equipment. The floor of the building is dirt and the dirt is discolored. The building measures roughly 150 feet by 30 feet.

b. Waste Characteristics:
There is no clear waste management taking place at this unit. However, the discolored soil floor suggests that spills of unknown material have occurred.

c. Migration Pathways:
If the dirt were contaminated, then constituents could leach out from rain water that collects inside and flow into the groundwater.

d. Evidence of a Release:
The is no clear evidence of a release of hazardous wastes or hazardous constituents.

e. Potential of Exposure:
Given the uncharacterized nature of the soil discoloration, it is not possible to conclude that any potential for exposure exists. This is an area of other concern, however.

Spill at Oil Tank, Lumber Yard Bldg. (SWMU No. 9)

a. Size and Location:
The oil tank holds roughly 500 gallons of an uncertain petroleum product. The ground around the blackened tank is black as well, for an area of approximately fifteen feet by thirty feet. The unit is within forty feet of an unnamed tributary to Lower Creek.

b. Waste Characteristics:
The exact nature of the waste (spilled material) is not known. It is a petroleum product; whether it was "fresh" new fuel or recycled "spent" fuel is uncertain.

c. Migration Pathways:
Migration (if any) from this unit is via the groundwater.

d. Evidence of a Release:
The areal extent of the spill is visible on the ground's surface. Given the nature of the operations at the Lumber Yard, it is likely that this has been a regular, non-sudden release.

e. Potential of Exposure:
The potential of exposure as a result of this spill is significant. The tank's proximity to the tributary to Lower Creek adds to the concern.

II. Visual Site Inspection

A. Visual Site Inspection Activities and Observations

The Visual Site Inspection (VSI) was attended by:

Bob Reimer	US EPA
Jill McCabe	NC DHR
Larry Fox	NC DHR
Richard McDonald	Singer

The VSI was conducted on November 30, 1987 at the Singer Furniture Company site in Lenoir, North Carolina. Mr. Jack Tripletts, the RCRA incinerator operator, was also interviewed during the site visit.

B. Update on Solid Waste Management Units Identified Above

The information collected during the VSI was used in preparing the summaries in Part I (c)(2) above.

C. Conclusions and Recommendations for Further Action

Old Landfill (SWMU No. 1)

A groundwater monitoring program is necessary to fully determine and assess the existence of any releases from the landfill. Corrective action would follow, as needed.

Abandoned Drums by Lower Creek (SWMU No. 2)

A formal investigation as to the source and the contents of the drums is needed. If it cannot be determined that the drums' contents posed no risk, then soil sampling and/or shallow groundwater monitoring is in order to determine if a release has occurred. Corrective action would follow, as needed.

Glue Wash Evaporation Pond (SWMU No. 3)

Surface soil sampling should be conducted in order to determine if any release has occurred. Corrective action would follow, as needed.Also, if the current, or any future, glues contain hazardous constituents, then this practice should be discontinued immediately.

Incinerator (SWMU No. 4)

No further action is required. The State RCRA permit will manage this unit.

Water Wash Storage Tank (SWMU No. 5)

No further investigation is required.

Hazardous Waste Storage Area (SWMU No. 6)

The surface soils adjacent to the storage area pad should be sampled for the same constituents historically present in the finishing residues. Corrective action would follow, as needed.

Waste Satellite Storage Area (SWMU No. 7)

No further investigation is required.

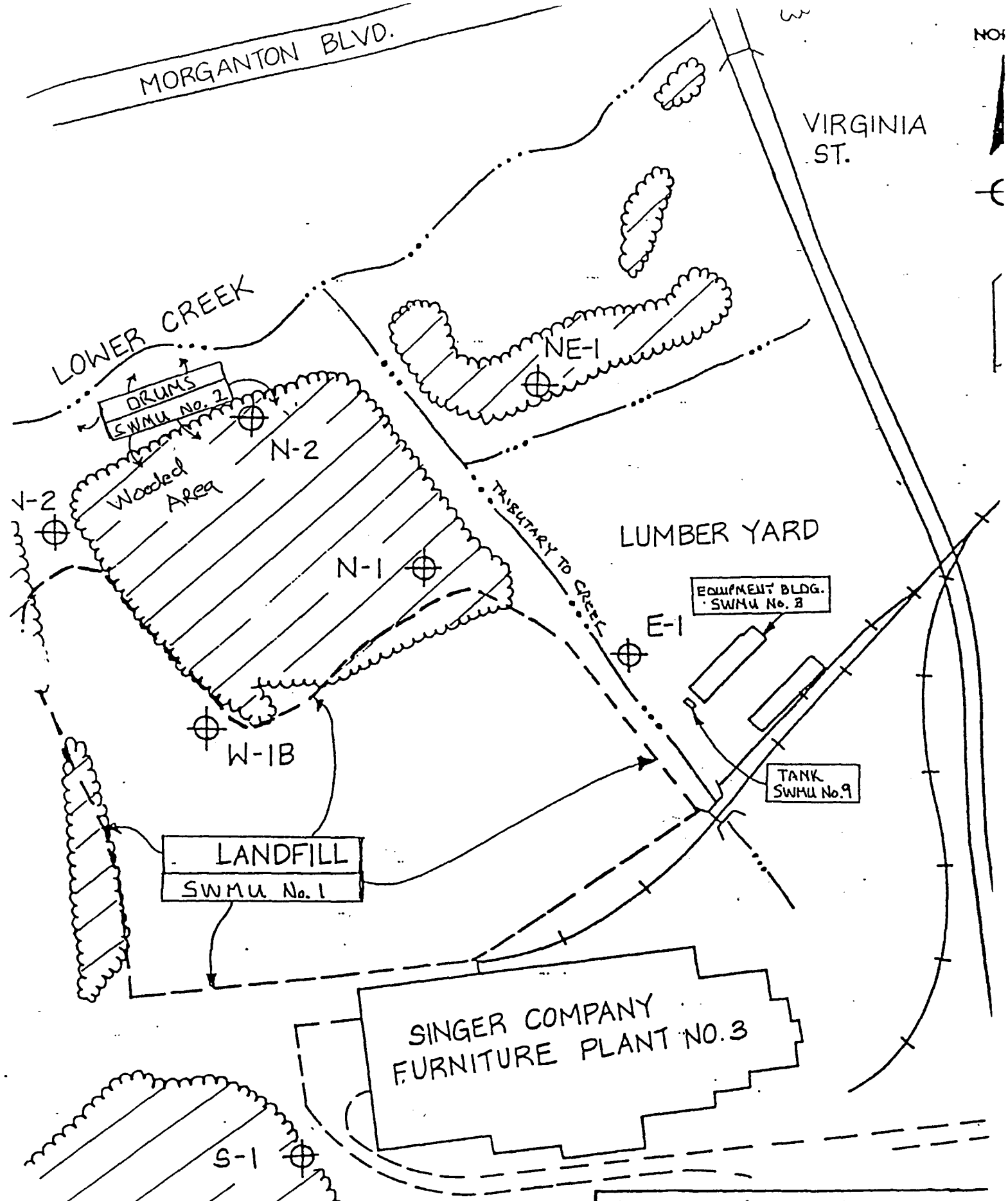
Floor Area, Lumber Yard Building (SWMU No. 8)

No further investigation is required.

Spill at Oil Tank, Lumber Yard Bldg. (SWMU No. 9)

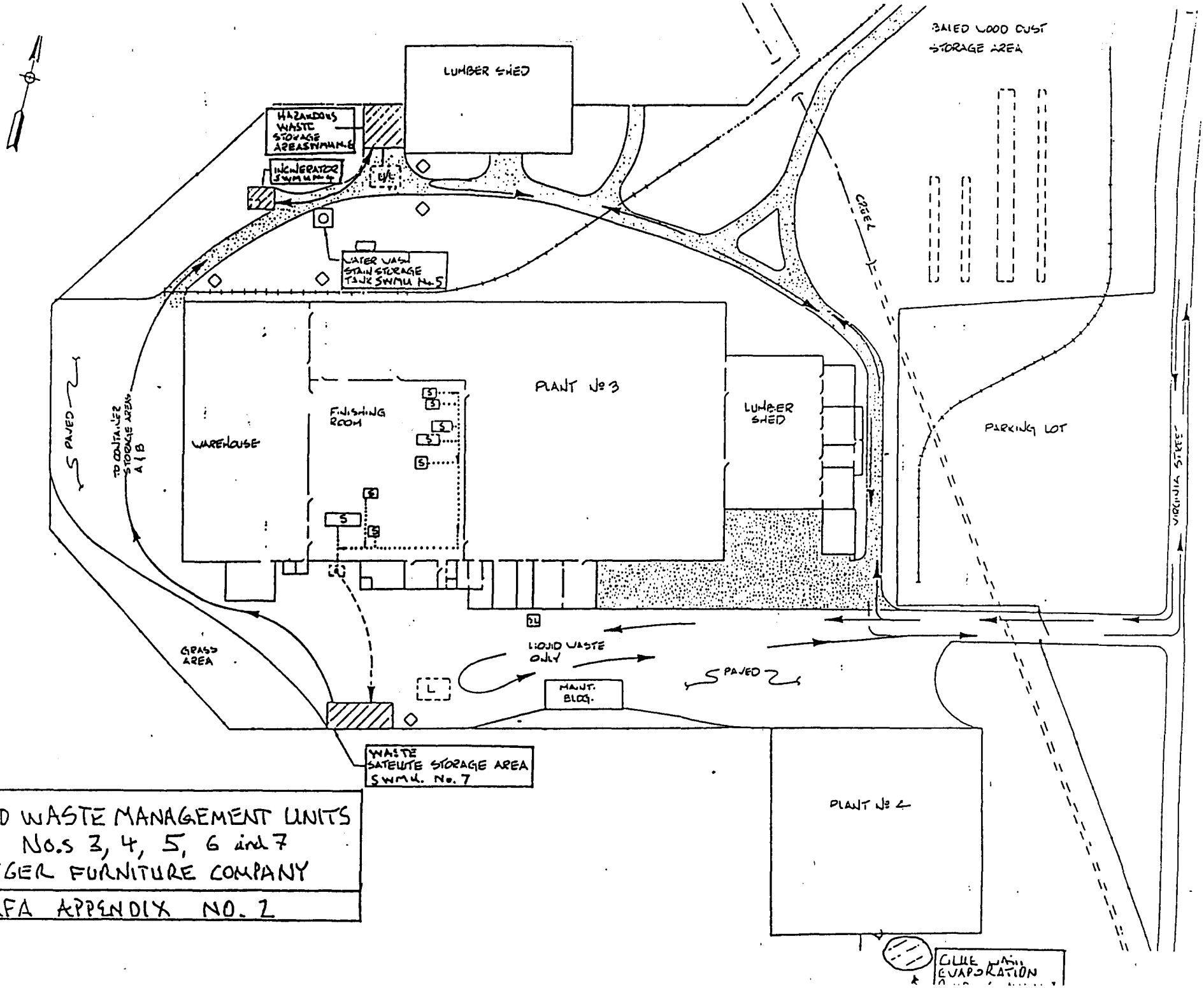
Local soil sampling and/or shallow groundwater monitoring is in order to determine if a release has occurred. If a release is confirmed, the nearby portions of the tributary to Lower Creek should be soil-sampled. Corrective action would follow, as needed.

III. Appendices (attached)



SOLID WASTE MANAGEMENT
Nos 1, 2, 8, 9
SINGER FURNITURE COMPA

RFA. APPENDIX NO. 1



SOLID WASTE MANAGEMENT UNITS
No.s 3, 4, 5, 6 and 7
SINGER FURNITURE COMPANY

RFA APPENDIX NO. 2

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SECTION 1

PURPOSE AND SCOPE

The purpose of this report is to identify corrective measures that may be used to contain, treat, remediate, and/or dispose of both onsite or offsite contamination that is discovered and quantified during the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the Singer Furniture Company's Miller Hill Complex located in Lenoir, North Carolina.

Sections 2 and 3 of this report provide a brief history of the Singer facility and a description of the Solid Waste Management Units (SWMU's), respectively, that are to be investigated during the facility's RFI. A description of the initial process of evaluating potential corrective measures is provided in Section 4 along with some of the critical elements of this initial evaluation. Section 5 provides descriptions of corrective measures that may be selected to contain, treat, remediate, and/or dispose of contamination that is identified at the facility during the RFI. The potential corrective measures described in Section 5 have been selected based on the current knowledge of the site. As additional data become available, the technologies described in this section may no longer be applicable and/or additional technologies may be evaluated. Section 6 provides a brief summary of the major components of site characterization and lists the field data requirement for each remedial technology described in Section 5. For each technology, the specific process data needs are listed along with why the data are required and how it can be collected. Finally, Section 7 presents the specific approach to the development of the RCRA Corrective Measures Study, which will be prepared following the implementation of the RFI.

SECTION 2

SITE BACKGROUND

Plant 33 of the Singer Furniture Company is located in the southern portion of the City of Lenoir, North Carolina, and is surrounded by residential, industrial, institutional, and recreational lands. The site consists of approximately 61 acres and is bounded by Virginia Street (formerly Miller Road), Fairview Drive, and Morganton Boulevard. The facility is an integrated case goods furniture manufacturing plant including rough end machining, sanding, cabinet assembly, finishing, packaging, and shipping operations.

The City of Lenoir used the northwestern portion of the property for solid waste and waste water management purposes prior to 1940 and until 1963. Industrial use of the Singer property is not visible in aerial photographs taken in 1940 and 1954. A 1956 topographic map shows a new rail spur and building at the same location as the existing equipment building. Furniture manufacturing operations, however, are clearly evidenced on the eastern portion of the property in aerial photographs taken in 1962. From 1963 to 1980 waste typical of furniture manufacturing (i.e., wood scrap, sawdust, finishes, glues, and strippers) were added to the municipal waste already in the landfill. In 1980, the landfill was closed, graded, and seeded.

Hazardous wastes generated by Singer consist of: 1) solid ignitable wastes in the form of filler scrapings, lacquer dust, and discarded rags and 2) liquid wastes in the form of stains, strippers, solvents, paints, and finishes. All are generated during the finishing of furniture. These wastes were generated at two Singer sites in Lenoir as well as plants in Roanoke, Virginia, and Washington, North Carolina. Singer wastes from offsite plants were transported by the U.S. Environmental Protection Agency (EPA) approved hazardous waste transporters to Singer Plant No. 33 in Lenoir. The

wastes were stored in closed drums until they were incinerated. Currently, on site generated waste is sent to authorized treatment, storage, and disposal facilities outside of the State of North Carolina. Singer no longer treats or disposes of solid waste on site. All wastes are containerized and shipped to government approved treatment or disposal facilities.

The permitted hazardous waste facilities did consist of a container storage area and an incinerator. Both of these areas, located on the north side of Plant No. 33, have been closed. An accumulation area, located on the south side of Plant No. 33, is currently used for temporary storage of hazardous wastes prior to offsite shipment.

Singer was issued a Hazardous Waste Management Permit on June 30, 1988, for the storage and incineration of discarded rags, filler scrapings, and lacquer dust associated with the manufacture of furniture. The Permit covers the facility located on 904 Virginia Street, SW, in Lenoir, Caldwell County, North Carolina, at latitude 35° 53'45" North, and longitude 81° 33'00" West.

According to the Permit, a RFI is to be conducted for each SWMU in order to define the source, identify the degree and the extent of any release of hazardous constituents, characterize the SWMU, and identify actual or potential receptors. Data to be developed during the RFI will supplement existing data. The sources will be examined to determine if any hazardous constituents are present and documentation of their impact on the surrounding environment will be detailed.

Singer's Part B Permit requires an RFI of the following SWMUs:

SWMU No. 1 - Old municipal and industrial landfill. Portions were previously owned by City of Lenoir. It was operated from pre 1940 until 1980.

SWMU No. 2 - Abandoned drums in Lower Creek floodplain. Drums were deposited during 1972 flood and partially removed in 1990.

SWMU No. 3 - Glue waste evaporation pond operated from 1979 to 1989. Visible residues were removed in 1990.

SWMU No. 6 - Hazardous waste container storage area was operated from 1980 to 1994 and clean closed in 1994.

SECTION 3

SOLID WASTE MANAGEMENT UNITS TO BE INVESTIGATED

SWMU's identified in Singer's RCRA Facility Assessment (RFA) Report must be investigated in the facility's RFI. This section provides a description and history of each SWMU to be investigated during the RFI. Results of previous investigations related to these areas are also included.

3.1 Old Landfill (SWMU No. 1)

The old landfill (SWMU No. 1), which is approximately six acres, is located immediately north of Plant No. 33 and west of the facility lumber yard. The precise boundaries of the landfill are not known and will be determined during the RFI.

Initially, the City of Lenoir used the western portion of the site for disposal of municipal refuse and sewage sludge during the late 1930s. Subsequent usage by Singer and a number of predecessors in the 1960s and 1970s may be confined predominantly to the central and western section of the site. Records regarding the nature or quantities of wastes that have been disposed at this landfill have not been found. It is apparent, however, that both municipal and industrial waste have been disposed of in the landfill because of its history of ownership.

Singer Furniture and its predecessors used the site for waste disposal generally during the period 1963 to 1978. Singer Furniture disposed of organic solvents, varnish, lacquers, paints, and other chemicals associated with the production and finishing of furniture. A portion of this material was disposed of in drums and a portion was burned in open pits in the landfill. Since disposal activity ceased in the late 1970s, the landfill has been leveled and a partial cover has been applied. In addition, the facility is covered with asphalt, rocks, or grass. The landfill is located on the Lower

Creek flood plain. Given the potential for release of leachate from the landfill to ground water, a ground water investigation and monitoring program was implemented in 1982. Seven ground water monitoring wells were installed in 1982 and 1983 as part of a two phase hydrogeological investigation of the landfill. From data gathered during subsequent ground water sampling it was determined that ground water beneath the landfill is moving in a general northwesterly direction toward the predominant area drainage feature (Lower Creek), a distance of approximately 600 to 800 feet from the landfill. Contamination has been detected in ground water samples from hydrogeological investigations of the landfill.

3.2 Abandoned Drums Along Lower Creek (SWMU No. 2)

Fourteen 55-gallon drums of unknown origin were located between the northern edge of the old landfill and Lower Creek. These drums were scattered along the creek and partially buried on the banks and the bed of the stream. The drums were discovered in 1987 in a densely foliated area of approximately 17,000 square feet. All drums were exposed to some degree. The drums were in various stages of decay and most were completely rusted through. The drum labels were worn off from exposure to the weather.

The drums were suspected of having floated onto Singer's property during a flood in 1970s. The original content of the drums is currently unknown. Liquid and silt or soil existed in some of the drums. Of the fourteen drums, a total of six drums were discovered partially full of unknown materials.

The drums found in this area have been removed and, unless additional drums are discovered, a very low potential currently exists for additional releases. Although there is no visual evidence of a release to soils at this SWMU and soil samples taken from each drum location indicated no significant contamination, a past release cannot be discounted. Releases to ground water may have also occurred. In addition to these concerns, Lower Creek sediments and surface waters may have been impacted due to overland flow or discharge of ground water contamination.

3.3 Glue Wash Evaporation Pond (SWMU No. 3)

The Glue Wash Evaporation Pond was a small impoundment approximately 20 feet in diameter and 1 to 2 feet deep located next to Building No. 4. This impoundment received a wash water mixture containing glue from 1979 to 1989. The glue/water mixture was allowed to evaporate in the pond. The material remaining after the water evaporated was a hard, plastic-like crust. This crust was periodically scraped out of the pond by hand or with a front-end loader and disposed of in the local sanitary landfill. This operation ended in 1989 and solids remaining in the impoundment were removed.

No known release from this unit has been documented. According to the RFA report there has been no evidence of a release from this SWMU. However, the potential for impact on soils and ground water via percolation from this unit cannot be discounted since there has been no confirmatory sampling associated with this unit.

3.4 Spill at the Lumber Yard Building Oil Tank (SWMU No. 9)

This SWMU was identified by an area of discolored soil approximately 30 feet by 15 feet. The discoloration was probably the result of overfills, spills, or leaks associated with an aboveground, approximately 500 gallon storage tank containing diesel fuel. The suspect area is located along the west wall of the lumber yard building. There are currently visibly stained soils in this area. Interviews with site personnel indicate that the tank contained only diesel fuel.

Diesel fuel is a fraction of crude oil that contains primarily organic compounds with 15 to 18 carbon atoms. Benzene, toluene, xylenes, ethylbenzene, and polynuclear aromatic hydrocarbons are constituents typically associated with the diesel fuel fraction. To date no samples from the spill area have been collected for laboratory analysis.

The suspected release of petroleum products to soils is based on discoloration of soils. Ground water in the immediate vicinity of this unit has not been investigated. Ground water flow is anticipated to be toward Lower Creek. Based on data from the

Landfill Phase I and II reports, depth to ground water at this SWMU is estimated at 8 to 10 feet. Therefore, a potential exists for release of petroleum products to ground water via contaminated soils as a secondary source. Releases directly to surface water are unlikely in the area. Surface water run-off during precipitation events, however, may have contained petroleum products and migrated towards Lower Creek via overland flow.

SECTION 4

INITIAL EVALUATION OF CORRECTIVE MEASURES

Initial evaluation of the proper permanent corrective measure requires consideration of the physical characteristics and geography of the site, as well as the nature and extent of contamination. Once all necessary site characterization has been identified, several factors concerning the potential corrective measures should be evaluated before a commitment is made to a particular approach. The extent of the evaluation will depend on the magnitude of the impacted area and the location of potential receptors. The factors that should be considered when evaluating corrective measure options can be broken down in four categories: 1) technical, 2) institutional, 3) human health and the environment, and 4) costs. Additionally, a risk analysis should be performed to assist in determining the appropriate cleanup levels. The following subsections address each of these separately. Figure 4-1 is a generic flow diagram showing the procedure for deciding the permanent corrective-action approach.

4.1 Technical Factors

4.1.1 Performance

Two aspects of corrective actions determine their desirability from a performance standpoint: effectiveness and useful life.

Effectiveness refers to how well the corrective action technology accomplishes its intended purpose, such as containment, diversion, removal, destruction, or treatment. The effectiveness of available alternatives should be determined either through design specifications or by performance evaluation.

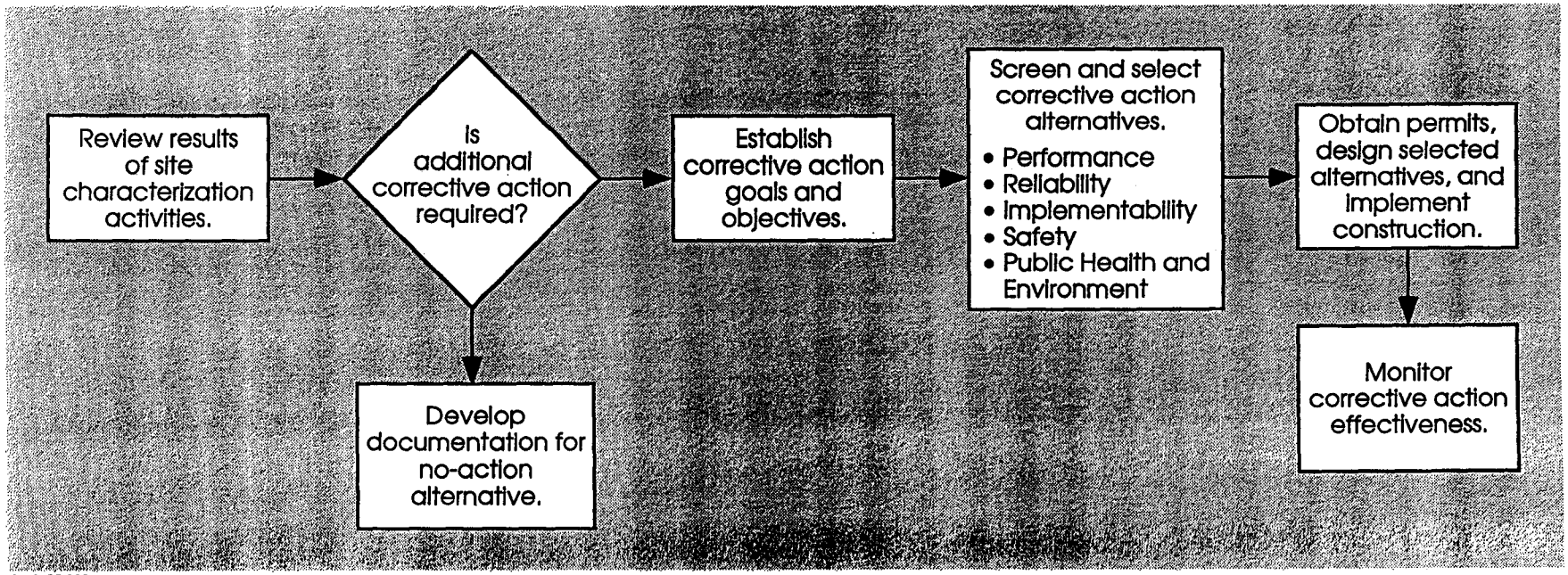

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Figure 4-1. Permanent Corrective Action Process

Useful life refers to the length of time a corrective action technology can maintain the desired level of effectiveness. Some corrective action technologies deteriorate with time. Such deterioration can sometimes be slowed down through proper system operation and maintenance, but the technology may eventually require replacement. Each corrective action alternative should be evaluated in terms of the projected service lives of its component technologies.

4.1.2 Reliability

Two aspects of corrective action technologies that provide information about reliability are operation and maintenance requirements (i.e., frequency and complexity) and demonstrated reliability at similar sites. Demonstrated and expected reliability is a way of measuring the risk and effect of failure. One should evaluate whether the considered technologies have been used effectively at similar sites; whether a combination of technologies has been used effectively; whether the failure of any one technology has an immediate impact on receptors; and whether the alternative has the flexibility to deal with uncontrollable changes at the site.

4.1.2 Implementation

Another important consideration in the selection process is whether the corrective action can be implemented with relative ease, i.e., whether it can be constructed or installed within the time frame required to achieve the desired results.

4.2 Institutional Factors (Regulatory Compliance)

The effects of Federal, State, and local standards and other institutional considerations on the implementation and operational timing should be analyzed. In addition to the regulatory requirements in the RCRA covering corrective action, regulatory programs under the Safe Drinking Water Act (SDWA), the Federal Water Pollution Control Act (Clean Water Act or CWA), the Toxic Substance Control Act (TSCA), and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) will often have some impact on corrective actions.

4.3 Human Health and Environmental Factors

4.3.1 Safety

Each corrective action alternative should be evaluated with regard to safety. This evaluation should include threats to the safety of nearby communities and environment as well as those to workers during implementation. Safety factors to consider are fire, explosion, and exposure to hazardous substances.

4.3.2 Human Health and the Environment

Consideration should be given to the effect of human health and any beneficial or adverse environmental impacts in the selection of corrective actions. The objective should be to improve public health and the environment to the extent site-specific conditions permit.

4.4 Costs

Both capital and operation and maintenance costs should be estimated. The estimate should reflect the scale of the planned corrective actions. Estimates for large, long-term corrective action options will require more detail. Application of a particular option is determined by conditions both internal and external to the site, such as the location of underground utilities, depth of the water table, heterogeneity of subsurface materials, and the site itself (i.e., whether it lies in a remote or a congested urban area).

4.5 Risk Analysis

Before a commitment is made to a specific corrective action strategy, the levels of acceptable risk should be established to assist in the determination of criteria for meeting cleanup objectives. Data obtained during the RFI and technology performance evaluations are used in this determination. An analysis could be made to forecast concentrations of the released substance in the media of concern. Based on

toxicity data and regulatory and environmental standards, the relative human and environmental hazard posed by exposure to various concentration levels can be assessed. The combination of the likelihood of exposure to the released substance and the hazard posed by such exposure provides a measurement of the relative risk involved. This relative risk factor can then be used to establish cleanup goals and to assist in the selection and design of appropriate corrective-action technologies.

SECTION 5

POTENTIAL CORRECTIVE MEASURES

This section provides descriptions of corrective measures that may be selected to contain, treat, remediate, and/or dispose of contamination that is identified during the RFI of Singer Furniture Company's Miller Hill Complex. The corrective measures described in this Section have been selected based on the current knowledge of the site. As additional data become available, the technologies described herein may no longer be applicable and/or additional technologies may be evaluated as potential corrective measures. The final selection of corrective measures will be made during the Corrective Measures Study, following the completion of the RFI and analysis of the data obtained.

5.1 Soil Excavation

The quantity of excavation required at a contaminated site depends on the volume of the contaminated media, the extent of the plume, and the remediation method chosen. Contaminated soils and earth materials are excavated with conventional construction equipment such as backhoes, draglines, front-end loaders, and even shovels. The type and size of the contaminated area determines the type of equipment required to effect a satisfactory cleanup. Generally, excavation should be considered when: 1) contaminated areas are small and involve wastes with relatively low toxicity, 2) a high hazard to drinking water supplies exists, 3) insoluble wastes cannot be removed by pumping alone, or 4) long-term treatment would be too costly.

The first step in the cleanup process involves excavation and proper disposal of the contaminated soils. Disposal could involve hauling the material to an approved hazardous or solid waste landfill, incineration on- or offsite, or some other treatment

technique (such as solidification, encapsulation, or solvent extraction and drying) conducted on- or offsite.

Excavation is ineffective as a total removal technique if the contaminants have spread over a large area. Factors such as soil types, ground and surface waters, and amount of precipitation can influence the degree to which a material has leached. Excavation of all contaminated substances (including ground water and strata through which it flows) is rarely performed because of the high costs associated with the transport and treatment or disposal of large volumes of soils.

5.1.1 Application/Availability

Although no absolute limitations are placed on the materials that can be excavated and removed, worker health and safety are strong considerations in the decision to excavate explosive, reactive, or highly toxic materials. Other factors that are considered include the mobility of the material, the feasibility of onsite containment or in-situ treatment, and the cost of disposing of or decontaminating the soil after it has been excavated. A frequent practice is to excavate and remove contaminant "hot spots" and to use other remedial measures for less-contaminated soils. Excavation and removal apply to almost all site conditions; however, such actions may become cost-prohibitive at great depths or in complex hydrogeologic environments.

5.1.2 Design and Construction Considerations

Regardless of the kind of equipment used for excavation and handling, certain standard operating procedures and safety practices should be followed.

During the excavation of the contaminated soils, air monitoring should be conducted to determine the presence of unsafe levels of various hazardous constituents. Numerous portable direct reading instruments are available for this purpose. These include:

- Combustible gas detectors for measuring the lower explosive limit (lowest concentration of flammable gas that will explode, ignite, or burn when an ignition source exists).

- Oxygen meters for measuring the percentage of oxygen.
- Photoionization detectors, flame ionization detectors, infrared analyzers, and detector tubes for measuring gases and vapors.

As contaminated soils are excavated from the disposal area, they should be transferred to box trucks or to a temporary storage area, preferably a diked or bermed area lined with plastic or low-permeability clay. A layer of absorbent material should be placed on the bottom of the temporary storage area. Gas analyzers are often used to determine the approximate level of contamination in soils so they can be segregated according to their degree of contamination. Pools of liquid wastes or solvent materials should be removed promptly by the use of pumps.

5.1.3 Costs

Total excavation costs will depend on the amount of excavating required. Table 5-1 presents some unit costs for excavating with different pieces of equipment.

TABLE 5-1. SOIL EXCAVATION COSTS[a]

Machine	Daily capacity, yd^3	Equipment cost per day, $
Backhoe with 3.5-yd^3 bucket	1200	2463
Crane with 3.0-yd^3 bucket	900	1623
Wheel-mounted bucket loader	1480	1550
Towed scraper, 10-yd^3 capacity	440	2189
Dump Truck, 12-yd^3 capacity, 1/4-mile haul	356	626

[a]Original data from EPA 1985, updated to 1994 costs using an inflation index of 1.216.

5.2 Capping

Capping refers to the process used to cover contaminated materials in place to prevent their contact with the land surface and ground water. The designs of modern

caps usually conform to the performance standards in 40 CFR 264.310, which addresses RCRA landfill closure requirements. These standards include minimum liquid migration through the wastes, low-cover maintenance requirements, efficient site drainage, high resistance to damage by settling or subsidence, and a permeability lower than or equal to the underlying liner system or natural soils. These performance standards may not always be appropriate, particularly when the cap is intended to be temporary.

A variety of cap design and capping materials are available. Most cap designs are multilayered to conform with the aforementioned design standards; however, single-layered designs are also used for special purposes. The selection of capping materials and cap design are influenced by special factors such as local availability and costs of cover materials, desired functions of cover materials, the nature of the wastes being covered, local climate and hydrogeology, and projected future use of the site in question.

5.2.1 Application/Availability

Capping is necessary whenever contaminated materials are to be buried or left in place. Capping also may be performed when extensive subsurface contamination at a site precludes excavation and removal of the soil because of potential hazards and/or unrealistic costs.

Capping is often performed together with ground water extraction or containment technologies to prevent (or significantly reduce) further plume development. This combined effort reduces the time needed to complete ground water cleanup operations. Ground water monitoring wells also are often used in conjunction with caps to detect any unexpected migration of the underlying material. Surface water control technologies such as ditches, dikes, and berms are also associated with capping, as these structures are often designed to control rainwater drainage from the cap and to minimize erosion caused by floods and run on. Two other surface water control technologies--grading and revegetation--are incorporated into multilayered caps.

Availability of capping material is somewhat site-specific because the local soils are typically used with admixtures to form parts of the cap. Synthetic membranes, which are available in varying sizes, can be overlain and spliced in the field. In general, capping should be a readily available technology for any contaminated site.

5.2.2 Design and Construction Considerations

The primarily purpose of the cap is to prevent rainwater infiltration. The two basic designs are multilayered and single-layered. Although multilayered caps are the more common, a single-layered cap may be acceptable when a site is being covered temporarily, in an area where little or no ground water exists, or when continual maintenance of the integrity of a cap cannot be absolutely assured. A vapor collection system should always be included in the design of a cover when there is any indication that significant quantities of the underlying contaminant are volatile.

The design of multilayered caps generally conforms to EPA's guidance under RCRA, which recommends a three-layered system consisting of an upper vegetative layer, a drainage layer, and an underlying low-permeability layer. Single-layered caps can be constructed of various low-permeability materials; however, natural soil admixes are not recommended because they are disrupted by freeze/thaw cycles and exposure to drying causes them to shrink and crack. The most effective single-layer caps are composed of concrete or bituminous asphalt. Construction considerations for single-layered caps vary depending on the cap materials used (e.g., concrete, asphalt, clay); therefore, appropriate construction guidance should be followed according to the cap material being considered.

Construction of a multilayered cap typically includes a vegetative layer based on topsoil, a drainage layer composed of sand, and a low-permeability layer formed by a combined synthetic and soil liner system. This type of cap function diverts infiltrating liquids from the vegetative layer through the drainage layer and away from the underlying contaminated materials.

The low permeability of a multilayered cap can be composed of natural soils, admixed soils, a synthetic liner, or any combination of these materials; however, a

synthetic liner overlying at least 2 feet of low permeability natural soil or soil admix is recommended because the synthetic liner allows virtually no liquid penetration for at least 20 years, whereas the soil layer provides assurance of continued protection even if the synthetic liner fails.

5.2.3 Costs

The cost of a cap depends on the type of materials selected, the thickness of each layer, and the area to be covered. The estimated installed cost of a multilayered cap is $6.60/ft^2. This cost includes 3 feet of topsoil overlying a 1-foot sand layer, overlying 1-foot of compacted clay overlying a 30-mil high density polyethylene (HDPE) liner overlying 2 feet of compacted clay. Filter fabric is included between the topsoil and sand drainage layer to prevent clogging. Quality control testing of each layer of the cap is included in the installation cost estimate.

The estimated cost for a single-layer cap comprised of a sprayed asphalt membrane is $4.80/sq yd.

5.3 Soil Vapor Extraction

Soil Vapor Extraction (SVE) is a widely used in-situ remediation technology for the treatment of contaminated vadose zone soil. SVE removes volatile organic compounds (VOCs) from vadose zone soils by inducing air flow through contaminated areas. SVE is typically performed by applying a vacuum to vertical vapor extraction wells screened through the level of soil contamination. The resulting pressure gradient causes the soil gas to migrate through the soil pores toward the vapor extraction wells. VOCs are volatilized and transported out of the contaminated soil by migrating soil gas. In addition, SVE increases oxygen flow to contaminated areas, thereby stimulating the natural biodegradation of aerobically degradable contaminants.

The performance of SVE improves as the air permeability of the vadose zone soil increases. SVE is applicable to compounds with vapor pressures greater than

approximately 1 mm Hg. Because vapor pressure increases with temperature, SVE can also be applied to semivolatile compounds by heating the vadose zone with steam or hot air.

5.3.1 Application/Availability

SVE systems can be used at any site where the needed excavation can be made for their installation. Systems of extraction wells, control trenches, and header piping are normally required, along with vapor pumping and disposal equipment. Active vapor control systems are not sensitive to the freezing or saturation of surface or cover soils.

5.3.2 Design and Construction Considerations

SVE systems consist of several components, all of which require different materials of construction and installation techniques. Specific material selection is at the discretion of the designer; however, the materials used should be those that experience has proven to perform satisfactorily. Corrosion resistance, flexibility, and ease of installation are of particular importance in the selection of materials and the design of the components for these systems, which generally will be somewhat temporary (i.e., expected system life is but a few years).

Approximate values for design criteria should be determined by vapor extraction tests on one or more test wells, during which the change in pressure gradient radially from the wells should be monitored. Other parameters that should be monitored during the tests are vapor extraction flow rates, subsurface negative (vacuum) pressures at various depths and distances from the well(s) and negative pressures within the well.

Active SVE systems can be implemented with conventional equipment, labor, and materials. Some mechanical equipment may require a delivery lead time of several months. Well drilling is accomplished with caisson, auger, and bucket rigs. A few systems having high-torque capacity also are needed to excavate through large obstacles that may be present. Pipe laying is similar to utility pipeline construction.

Implementation of active vapor control systems requires little time. Several wells can be completed by a single crew in a day (equivalent to several hundred feet of perimeter per day), and collection piping and mechanical components can be installed concurrently. Vapor control can be implemented upon completion and startup, and immediate results (as measured in monitoring probes) are realized.

5.3.3 Costs

The capital costs of SVE systems vary greatly and depend on the size and depth of the plume, the nature of the contaminant, and the selected design criteria. Table 5-2 shows unit costs for typical components of a SVE system. The large range of unit costs is due to the variable nature of the system, which depends on the characteristics of the plume in question. Unit costs for deep extraction wells will be greater than those for shallower wells because more specialized equipment is needed. Likewise, large-diameter header pipe is more costly than smaller pipe because material and labor costs are higher. Blower/treatment facilities may vary in scale from a small blower with a vent stack to multiple, high-volume blowers with or without multiple and/or high-volume burners, automatic timers, valves, switches, and recorders. Costs are generally in the $250,000/acre without vapor treatment and $350,000/acre with vapor treatment.

5.4 Biostimulation

A contaminated site might be restored through biostimulation, a technology whereby naturally occurring soil microorganisms are stimulated to biodegrade the waste. The basic concept involves altering environmental conditions to enhance microbial catabolism or cometabolism of organic contaminants, which results in the breakdown and detoxification of those contaminants. This technology has developed rapidly over recent years and appears to be one of the most promising of the in-situ treatment techniques.

The biostimulation method that has been most developed and is most feasible for in-situ treatment is one that relies on aerobic (oxygen-requiring) microbial

TABLE 5-2. 1986 UNIT COSTS FOR COMPONENTS OF ACTIVE SVE SYSTEMS[a]

Item	Range of Unit Costs, $
Vapor-extraction well (drilling, stone, piping, etc.), in place	60 to 100/vertical foot
Well connection lateral (10-ft piping valve, excavation, fittings, etc.), in place	1,200 to 1,800 each
Vapor-collection header (piping, excavation, fittings, etc.), in place	25 to 130/linear foot
Blower facility [blower(s), safety devices, valves, foundation, piping, fencing, electrical components, and service connection], in place	60,000 to 125,000 (total)
Monitoring probe (drilling, pipe, fittings, backfill, etc.), in place	12 to 18/vertical foot
Operation and maintenance	6,000 to 25,000/year
Monitoring with portable meter	12 to 18 each visit

[a]Original data from EPA 1985, updated to 1994 costs using an inflation index of 1.216.

processes. This method involves optimizing environmental conditions by providing an oxygen source and nutrients, which are delivered to the subsurface through an injection well or infiltration system for the enhancement of microbial activity. Indigenous microorganisms can generally be relied upon to degrade a wide range of compounds given proper nutrients and sufficient oxygen.

5.4.1 Application/Availability

Considerable research conducted over the past several decades has confirmed that microorganisms can break down many of the organic compounds that are common contaminants. Laboratory, pilot, and field studies have demonstrated that microorganisms can be used in-situ to reclaim contaminated soils and ground water.

The feasibility of biostimulation as an in-situ treatment technique is dictated by waste and site characteristics. The following factors determine the applicability of a biostimulation approach:

- Biodegradability of the organic contaminants
- Environmental factors that affect microbial activity
- Site hydrogeology.

The most rapid and complete degradation of most compounds occurs aerobically. Some compounds, most notably the lower-molecular-weight halogenated hydrocarbons, will only degrade anaerobically. In general, aerobic techniques are most suitable for the degradation of petroleum hydrocarbons, aromatics, halogenated aromatics, polyaromatic hydrocarbons, phenols, halophenols, biphenyls, organophosphates, and most pesticides and herbicides. Anaerobic techniques under very reducing conditions appear to be most feasible for the degradation of lower-molecular-weight halogenated hydrocarbons such as unsaturated alkyl halides (e.g., PCE and TCE) and saturated alkyl halides (e.g., 1,1,1-trichloroethane and trihalomethane). Aerobic degradation in the presence of methane gas, however, appears to be promising for some low-molecular-weight halogenated hydrocarbons.

The availability of the compounds to the organism also dictates its biodegradability. Compounds with greater aqueous solubilities are generally more available to degrading enzymes. For example, cis-1,2-dichloroethylene is preferentially degraded relative to trans-1,2-dichloroethylene. The most likely explanation for this is that "cis" is more polar than "trans" and is therefore more water soluble. The use of surfactants can increase the solubility and therefore the degradability of compounds.

5.4.2 Design and Construction Considerations

The feasibility and effectiveness of biostimulation as an in-situ treatment method is determined by the microbial population, the biodegradability of the organic contaminants, and a host of environmental factors that affect microbial activity. High concentrations of contaminants and deficient soil conditions (such as low moisture

content) will adversely affect biodegradation, as will extremes of pH, temperature, and nutrient levels. In general, optimum environmental conditions are 1) pH of 7.0 to 8.5, 2) temperature of 15° to 35° C, 3) nutrient levels of nitrogen and phosphorus, and 4) 40 percent by weight moisture of soil. Adequate mixing (aeration or cultivation) is also needed.

Oxygen can be provided to the subsurface through the use of air, pure oxygen, hydrogen peroxide, or possibly ozone. Air can be added to extracted ground water before reinjection, or it can be injected directly into the aquifer. The first method, known as in-line aeration, involves adding air into the pipeline and mixing it, with a static mixer for example. A pressurized line can increase oxygen concentrations, as can the use of pure oxygen.

Bioreclamation also requires the presence of nutrients in the soil to effect biodegradation. Nitrogen and phosphate are the nutrients most frequently present in limited concentrations in soils. Other nutrients required for microbial metabolism include potassium, magnesium, calcium, sulfur, sodium, manganese, iron, and trace metals. Many of these nutrients may already be present in the soil or ground water in sufficient quantities and need not be supplemented.

The several design alternatives available for delivering nutrients and oxygen to the subsurface and for collecting and containing the ground water can generally be categorized as gravity-flow or forced methods. Most of the systems that have been used in biostimulation projects involve subsurface drains (gravity system), injection wells, and extraction wells.

Implementation of a remedial action involving biostimulation will take longer than excavation and removal of contaminated soils. Depending on the specific site, it could also take longer than a conventional pumping and treating approach. The advantage of in-situ biodegradation over the latter approach is that in-situ biodegradation treats contaminated subsurface soils and thus removes the source of the contamination.

5.4.3 Costs

Costs for biological in-situ treatment are determined by the site's geology and geohydrology, the extent of contamination, the kinds of concentrations of contaminants, and the amount of ground water and soil requiring treatment. There is no easy formula for predicting costs. Costs provided for actual site cleanups indicate that biological treatment can be far more economical as an alternative to, or in conjunction with, excavation and removal or conventional pumping and treating methods. For example, at a small half-acre site where petroleum based naptha products leaked from a tank over the course of several years, the cost to bioremediate this site was approximately $150,000 in 1994. This site did not require the addition of oxygen, since the contamination was confined to the surface, and the contamination was limited to an area approximately 30 feet by 30 feet. Conversely, at another site where oxygen addition was necessary, and contamination had spread underneath several buildings on site, the cost to bioremediate the site approached $500,000 in 1994.

5.5 Solidification/Stabilization

Solidification and stabilization methods of treating contaminated soils are applied to change the physical or leaching characteristics of the waste or to decrease its toxicity. In the solidification process, waste constituents are mechanically locked within a solidified matrix in the form of a crumbly soil-like mixture or a monolithic block similar to concrete. Although solidification improves the waste handling or other physical characteristics of the waste, it usually has little effect on the chemistry of the waste; therefore, leaching of waste constituents may occur in the future. Solidification may be accomplished by the use of portland cement or a lime-containing product (e.g., fly ash, ground blast furnace slag, or cement kiln dust). Solidification can also be accomplished by the use of an organic polymer. In this case, the waste is mixed with a prepolymer and solidified when a catalyst is added. In a third form, known as

thermoplastic solidification, the waste is mixed with heated bitumen, paraffin, or polyethylene; this mixture solidifies upon cooling.

Stabilization is a chemical reaction that fixes substances in a matrix that results in a decrease in the solubility or toxicity of the hazardous waste constituents. Whereas stabilization reduces the solubility or mobility of waste constituents, it may not improve the physical handling characteristics. Therefore, solidification and stabilization are often combined to obtain the desired effects of both processes. This is accomplished by combining alkaline earth materials (such as lime, cement kiln dust, siliceous materials, or cement) with organic polymers and proprietary chemicals.

5.5.1 Application/Availability

Cement- and lime-based processes capable of solidifying a wide range of materials are readily available. The materials must be amenable to forming a slurry with water. Thermoplastic and organic polymer processes, on the other hand, are often developed on a waste-specific basis and involve the use of proprietary chemicals and procedures.

5.5.2 Design and Construction Considerations

Cement- and lime-based processes require readily available equipment such as chemical storage hoppers, chemical feeding equipment, mixing equipment (ribbon blenders and single- and double-shaft mixers), and waste handling equipment. Thermoplastic and organic polymer processes require special equipment and trained operators, generally provided by vendors who are conducting the proprietary solidification process.

Lime-based solidification also can be conducted on a batch basis in drums. In addition to chemical storage and batching equipment, drum handling and mixing systems are needed. Some firms have developed drum kits. In this type of application, earth-moving equipment (backhoes, shovels, etc.) is required in addition to chemical storage and mixing equipment.

5.5.3 Costs

Solidification/stabilization costs vary widely with the specific wastes and process used; however, some general guidelines are available. In-drum solidification/ tabilization can typically cost $335 per ton assuming 49 gallons of untreated waste per drum and an average processing rate of 4.5 drums per hour. Whereas solidification/stabilization of wastes in a lagoon would cost $40 per ton if the waste was mixed in place by a backhoe and remained in the lagoon for disposal. Offsite solidification/stabilization for pumpable sludges can cost up to $50 per ton and nonpumpable sludges may cost up to $62 per ton, assuring no more than 200 miles of transportation of the sludge. Disposal costs are additional for the offsite solidification/stabilization.

5.6 Ground Water or Leachate Pumping/Containment

Ground water pumping/containment technologies are implemented to contain or remove a containment plume. These measures are also frequently used to alter the direction of ground water flow or to adjust ground water levels. Many of these measures can also be used to collect or contain subsurface leachate. Ground water pumping/ containment technologies can be grouped into two main categories which can be considered either active or passive. Active technologies include direct containment and removal of contaminated ground water through the use of recovery wells, well points, or interceptor trenches. Passive technologies function to redirect the flow of ground water or to confine the affected ground water to a specific area through the use of slurry walls or sheet piles. The use of a given technology is dependent on hydrogeologic conditions and remediation goals.

5.6.1 Active Ground water/Leachate Containment Methods -- Applicability

Recovery wells are typically used where the soil is fairly permeable with depth and where there is sufficient saturated thickness below the level where the water table is to be lowered to enable adequate submergence of the well screen and pump.

Recovery wells with individual submersible pumps can be installed within or on the perimeter of the zone to be contained. Spacing is normally on the order of several tens of feet. Recovery well diameters are commonly 6 to 10 inches and screen lengths are commonly 20 to 40 feet. On occasion, larger diameter wells are used for dual phase recovery with separate pumps for product and dissolved phase removal.

Well point systems are generally constructed of small well screens less than 4 inches in diameter and less than five feet long. Individual well points are usually installed at 5 to 10 foot centers, attached to a common header pipe and connected to a well point pump. Well points are used in fairly cohesive and fine grained soils where the maximum drawdown from ground surface is less than 15 to 20 feet, and where deep artesian pressure does not need to be reduced. Well points are effective were the desired drawdown depth is only a short distance above an impermeable layer.

Interceptor trenches are constructed by excavating a continuous slot in the subsurface and backfilling the excavation with a permeable material to permit drainage. Continuous perforated drainage pipe can also be installed in the bottom of the trench where the collected water is pumped out for treatment. Interceptor trenches need not fully penetrate the saturated zone and they provide a continuous positive cutoff of ground water and/or leachate where contaminant breakthrough is not likely to occur. Impermeable barriers installed on the downgradient sides of trenches can also enhance the recovery and containment of impacted ground water. Interceptor trenches are best suited for low permeability soils with a shallow depth to ground water to minimize construction constraints.

5.6.1.1 Design and Construction Considerations--

Wells --

Several factors must be considered in the design of a pumping well system. These include the hydrogeologic setting, the objective of the well system, and expected installation difficulties. The extraction of water from wells can be for removal of contaminated ground water, control of ground water (plume) flow, or both. The discharge from wells that are to be used to extract contaminated ground water must

be directed to some treatment facility. Water removed from wells used for ground water control can be discharged remotely or used locally to enhance the ground water control system. Treated contaminated ground water also can be used as recharge water to control ground water flow.

A complete hydrogeological understanding of the site should be established prior to the design of a well system. The design must address the following items: the number and type of wells needed, their pattern, and their spacing; the radius of influence of the wells; the required pumping rates; and whether equilibrium or nonequilibrium pumping will be used.

Determination of the proper spacing of wells for complete capture of the ground water plume is probably the most important item in system design. Field practitioners have long had a standing "rule of thumb" for estimating well spacing: adjacent cones of depression should overlap (i.e., radii of influence should overlap). This method is reasonably accurate for aquifers that have low natural flow velocities, but it will not be valid for aquifers with high natural flow velocities.

Determining the radius of influence for a well in a given aquifer is critical in corrective action design because it affects well spacing, pumping rates, pumping cycles, and screen lengths. The radius of influence of a well increases as pumping continues until equilibrium conditions are reached (i.e., when aquifer recharge equals the pumping rate or the discharge rate).

Interceptor Trenches --

The major elements to consider in designing an interceptor trench system include:

- Location and spacing of drains to achieve desired head levels.
- Hydraulic design of the conduit, including pipe diameter and gradient.
- Properties and design of the envelope and filter materials.
- Design of a pumping station.

Determining the required location for an interceptor trench is more often based exclusively on the use of field data than on theoretical design. Site investigation data

are used to develop potentiometric surface maps, hydraulic conductivity data, plume boundary limits, and geologic cross sections. With these data in hand, the design engineer can pinpoint and stake the design drain line.

To function properly an interceptor trench should be installed perpendicular to ground water flow direction. In stratified soils having greatly different hydraulic conductivities, the drain should rest on a layer of low hydraulic conductivity. If the trench is cut through an impervious stratum, a significant percentage of the product moving laterally could bridge over the drain and continue downgradient. Similarly, if soil layers or pockets with high hydraulic conductivity underly the drain, the substance could flow beneath the drain.

5.6.1.2 Costs--

Costs of well systems and interceptor trenches for plume management can vary greatly from site to site. Some of the factors that determine these costs are the geology, the characteristics of the contaminated and naturally occurring ground water, the extent of contamination, the periods and duration of pumping, local wage rates, the availability of supplies and equipment, and the electrical power required. Costs associated with a well or trench system can be categorized as mobilization costs, installation and removal costs, and operation and maintenance costs.

Completion of a 6 to 10 inch recovery well will cost between $50 and $100 per foot of depth, depending on the drilling method and the materials of construction. Mobilization of the drill rig will require an additional $200 to $1000. There are three main types of pumps that can be used in a ground water recovery system: jet pumps, submersible pumps, and vacuum pumps. These range in cost starting at approximately $250 for a jet pump to over $50,000 for a large capacity vacuum pump. Submersible pumps usually cost between $500 and $2000.

Costs for installation of an interceptor trench can vary widely, however, the most significant factor contributing to cost differences is the depth of the trench. For example, a 3 foot deep trench may cost approximately $8.50 per foot, whereas a 12

foot deep trench may cost $80 per foot. The deeper trench includes costs for shoring required to support the trench wall.

5.6.2 Passive Ground Water Containment Methods -- Applicability

Slurry walls, also known as grout curtains, are ground water cutoff trenches that are backfilled with an impermeable material such as bentonite. Slurry walls can effectively cutoff containment migration if they can be tied into an impermeable base which is not too deep. Slurry walls are best suited for relatively low permeability conditions in shallow aquifers.

Slurry walls can be placed (relative to the direction of ground water flow) upgradient, downgradient, or completely surrounding the site of contamination. Circumferential installations, by far the most common, offer several advantages. This placement vastly reduces the amount of uncontaminated ground water entering the site on the upgradient side. Also, if no compatibility problems exist between the contamination and the wall materials, it will reduce the amount of contamination leaving the downgradient side of the site. Moreover, the use of this configuration in conjunction with an infiltration barrier and a collection system (or other means or reducing the hydraulic head on the interior of the wall) can maintain the hydraulic gradient in an inward direction, which prevents escape of the contamination.

Sheet piles are steel plates driven into the subgrade below the water table and secured into an impermeable base at depth. For sheet piles to be feasible the impermeable base must not be too deep. This containment method is most appropriate for developing flow barriers and containment cells for short-term dewatering projects. Sheet piles are best suited for shallow water table conditions of low to moderate permeability.

Steel sheet piling is seldom used as a ground-water barrier because costs are high and wall integrity is unpredictable. It is used more frequently for temporary dewatering in other construction or as erosion protection where some other barrier, such as a slurry wall, intersects flowing surface water.

One of the largest drawbacks of sheet piling, or any other barrier technology requiring pile driving, is that rocky soils tend to damage or deflect the piles and may render this approach ineffective as a ground water barrier.

5.6.2.1 Design and Construction Considerations--

Slurry Walls --

Several factors must be considered in the design of a slurry wall. First, a detailed, design-phase investigation must be conducted to characterize subsurface conditions and materials as well as to address the disposition and nature of the contamination. The issue of wall compatibility also should be addressed early in the design stage by permeability testing of the proposed backfill mixture with actual site materials. The design-phase investigation results can be used to decide on the optimum configuration and to select any ancillary measures needed to enhance the performance of the wall.

Construction of a slurry wall is relatively straight-forward. The required equipment depends on the depth and length of the wall. For walls up to 80 feet deep, a backhoe or modified backhoe is used for excavation. Deeper installations require the use of a mechanical or hydraulic clamshell or, in rare cases, a dragline. In small-volume wall installations batch slurry and backfill-mixing systems may be used, whereas large jobs require flash slurry mixers and a large backfill mixing area.

Sheet Pilings--

The primary design parameters for sheet piling are its dimensions and permeability. Dimensional requirements, which are based on site characteristics, are straightforward. Depth limitations are governed by the soil material at the site. On the other hand, design factors for ultimate permeability of the cutoff are more complicated and must assume some factor to account for leakage through the interlocking joints.

For construction of a sheet piling cutoff, the pilings are assembled at their edge interlocks before they are driven into the ground to ensure that earth materials and added pressures will not prevent a good lock between piles. The piles are then driven

a few feet at a time over the entire length of the wall. This process is repeated until the piles are all driven to the desired depth.

5.6.2.2 Costs--

Costs of slurry walls are highly site-specific. A typical installation based on a trench 4 ft wide x 40 ft deep x 100 ft long filled with bentonite/water slurry would cost approximately $375 per linear foot of trench.

Costs of installed steel sheet piling will vary with depth, total length, type of pile (coated or uncoated), and relative ease of installation. Average costs range from approximately $8 per square foot up to approximately $20 per square foot.

5.7 Ground Water or Leachate Treatment Methods

Contaminated ground water or collected leachate may be treated using several different treatment methods. Treated ground water or leachate can be discharged to a sewer, surface water, or injected back into the aquifer. Some common ground water treatment methods include air stripping, carbon adsorption, ion exchange, and precipitation.

5.7.1 Application/Applicability

Air stripping is an effective process for treating ground water contaminated with volatile organics. The air stripping process is best suited to compounds having a Henry's Law constant of >1. Air stripping is accomplished by passing air through contaminated ground water which typically entails counter current air-water flow over a high surface area support. This induces the movement of VOC's from the dissolved phase to the vapor phase.

Carbon adsorption is also used to remove dissolved organic compounds from contaminated ground water. Carbon adsorption involves passing contaminated water through a bed of activated carbon which selectively adsorbs the contaminated onto the carbon. When the activated carbon has been used to its maximum adsorptive capacity it is removed for disposal, destruction, or regeneration. Compounds

effectively treated include chlorinated pesticides, phenols, aliphatic chlorinated hydrocarbons, and aromatics. Carbon adsorption is an effective and reliable means of removing low-solubility organics over a broad range concentration.

Ion exchange is a reversible process in which an interchange of ions occurs between a solution and an essentially insoluble solid in contact with the solution. Ionic contaminations are removed from the aqueous phase by being exchanged with relatively non-toxic ions held by the ion exchange material. The extent to which removal of anions and cations occurs is dependent on the nature and volume of the contaminant ion, the type of exchange material and its saturation, and the ion in the contaminated aqueous solution. Ion exchange can be used in removing cationic and anionic metallic elements, halides, cyanides, nitrates, carboxylics, sulfonics, and some phenols.

Precipitation is a physicochemical process whereby some or all of a substance in solution is transformed into a solid phase. The process is based on alteration of the chemical equilibrium relationships affecting the solubility of inorganic species. Removal of metals as hydroxides or sulfides is the most common precipitation application in ground water or leachate treatment. Generally, lime or sodium sulfide is added to the contaminated ground water or leachate in a rapid-mix tank along with flocculating agents. The contaminated water flows to a flocculation chamber in which adequate mixing and retention time is provided for agglomeration of precipitate particles. Agglomerated particles are separated from the liquid phase by settling in a sedimentation chamber and/or by other physical processes, such as filtration.

5.7.2 Design and Construction Considerations

Air Stripping--

The design of a process for air stripping volatile organics from contaminated ground water or leachate is accomplished in two steps. The first step involves determining the cross-sectional area of the column by using the physical properties of the air flowing through the column, the characteristics of the packing, and the air-to-water flow ratio. The selection of the design air-to-water ratio must be based on

experience or pilot-scale treatability studies. Treatability studies are particularly important for developing design information for contaminated ground water. In the second step, the column height is determined mathematically from the physical properties of the contaminant and the stripping air.

Installation of a unit usually requires field assembly of equipment or placement of shop-fabricated/packaged units. Installation of the complex tower internals is the most labor-intensive task. Overall, however, installation of an air stripper is relatively simple and can be conducted by most mechanical contractors.

Carbon Adsorption--

Carbon adsorption is frequently used following biological treatment and/or granular media filtration. These treatments reduce the organic and suspended solids load on the carbon columns. It is also used to remove refractory organics that cannot be biodegraded. Air stripping also may be applied prior to carbon adsorption to remove a portion of the volatile contaminants and thereby reduce the organic load to the carbon column. These pretreatment steps all minimize carbon regeneration costs.

Like air stripping, carbon adsorption systems are relatively compact and easy to operate. On the other hand, the phenomenon of adsorption is extremely complex and not mathematically predictable. Field pilot-plant studies are necessary for the accurate prediction of the performance, longevity, and operating economics of carbon adsorption. The following data need to be established during pilot-plant testing for an initial estimate of carbon column sizing:

- Hydraulic retention time (hours)
- Flow (gallons/minute)
- Hydraulic capacity of the carbon (gallons waste/pound carbon)
- Collected volume of treated ground water at breakthrough (gallons)
- Carbon density (pounds carbon/cubic foot).

Ion Exchange --

Specific ion exchange and sorptive resin systems must be designed on a case-by-case basis. Of the three major operating models (fixed-bed cocurrent, fixed-bed

countercurrent, and continuous countercurrent), fixed-bed countercurrent systems are the most widely used. The continuous countercurrent system is suitable for high flows. Complete removal of cations and anions (demineralization) can be accomplished by using the hydrogen form of a cation exchange resin and the hydroxide form of an anion exchange resin. For removal of organics as well as inorganics, a combination adsorptive/demineralization system can be used. In this system, lead beds carry sorptive resins that act as organic scavengers, and the end beds contain anion and cation exchange resins. The use of different types of adsorptive resins (e.g., polar and nonpolar) permits removal of a broad spectrum of organics.

Ion exchange is a well-established technology for removal of heavy metals and hazardous anions from dilute solutions. Ion exchange can be expected to perform well for these applications with fed wastes of variable composition, provided the system's effluent is continually monitored to determine when resin bed exhaustion has occurred. As mentioned previously, however, the reliability of ion exchange is markedly affected by the presence of suspended solids. The use of sorptive resins is relatively new, and reliability under various conditions is not as well known.

Ion exchange systems are commercially available from several vendors. The units are relatively compact and are not energy-intensive. Startup or shutdown can be accomplished easily and quickly. These features allow for convenient use of ion exchange and sorptive resin systems in mobile treatment systems.

Precipitation --

Selection of the most suitable precipitate or flocculent and their optimum dosages are determined through laboratory-jar test studies. In addition to determining the appropriate chemicals and optimum chemical dosages, the following important parameters need to be determined as part of the overall design:

- Most suitable chemical addition system
- Optimum pH requirement
- Rapid mix requirements
- Sludge production

- Sludge flocculation, settling, and dewatering characteristics.

The system is relatively simple. The process requires only chemical pumps, metering devices, and mixing and settling tanks, all of which are readily available and easy to operate. Precipitation and flocculation can be easily integrated into more complex treatment systems, and they pose minimal safety and health hazards to field workers. The entire system is operated at near ambient conditions, which eliminates the danger of high-pressure/high-temperature operations. The chemicals employed are often skin irritants, but they can easily be handled in a safe manner.

5.7.3 Costs

The costs for these ground water or leachate treatment systems are highly dependent on the volume of contaminated water treated, levels and types of contaminants, types of equipment selected, and local construction costs (if the treatment units are built on-site). Onsite package waste water treatment systems range in costs from $70,000 to $300,000 installed. If offsite treatment is used, the transportation costs will often limit the treatment choices to those that are located within a reasonable distance. Use of private or publicly owned waste water treatment works is often available at costs ranging from $0.03 to $0.18 per gallon plus $4.00/mile per 5000 gallons.

5.8 Levees and Floodwalls

Levees are earthen embankments that create a barrier to confine floodwaters to a floodway and to protect structures behind the barrier. Levees are constructed of erosion-resistant, low-permeability soils (i.e., clay), or compacted, impervious fill. Floodwalls are similar to levees, except that they are constructed of concrete. Levees generally require a very large base width; therefore, in areas where there is limited space and fill material, concrete floodwalls are preferred.

For hazardous waste sites, levees and floodwalls help to control major losses of waste and cover material and prevent massive leachate production and subsequent contamination from riverine or tidal flooding.

5.8.1 Application/Applicability

Flood containment levees may be constructed as perimeter embankments surrounding disposal sites located in floodplain fringe areas, or they may be installed at the base of landfills along slope faces that are subject to periodic inundation. Levees serve to protect land disposal sites from flood waters, which may erode cover materials and transport waste materials offsite, or which may add water to waste materials and thus increase hazardous leachate production.

Levees and floodwalls are most suitable in flood fringe areas or areas subject to storm tide floodings. They are not suitable for areas with direct open floodways. Federal Emergency Management Agency (FEMA) and the U.S. Army Crops of Engineers regulations may limit the use or placement of floodwalls and levees. Hydraulic analysis of the impact of the embankment on flooding characteristics of the waterway may be required. Flooding from storm runoff behind a levee and/or floodwall may also be a problem; reduced flow storage capacity increases potential for downstream flooding.

5.8.2 Design and Construction Considerations

Levees and floodwalls are generally designed with a height capable of withstanding a 100-year flood (usually 2 ft of freeboard above the 100-yr flood elevation). A 10 ft minimum top width is required for levees to allow access for construction and maintenance equipment. Levees are generally constructed of compacted impervious fill. Ideal construction of levees is with erosion-resistant, low permeability soils, preferably clay. Drainage structures are often needed to drain the area behind the levee or floodwall. Typically used drainage structures include: diversion ditches, gravel-filled trenches, tile drains, sumps, and/or pressure conduits. If seepage problems occur, it may be necessary to construct a compacted impervious

core or sheet-pile cut-off extending below the levee to bedrock. Excess seepage can be collected with gravel-filled trenches or drains along the interior edge of the levee or floodwall. Vegetation or rip-rap can be used to protect levee bank slopes from erosion. Upslope interceptor ditches, diversions, or grassed waterways may be used to prevent backwater flooding from runoff falling on the drainage area behind the levee or floodwall.

5.8.3 Costs

Costs associated with constructing and maintaining levees and floodwalls will depend on site-specific design variables, availability of suitable embankment soil, and the local frequency and magnitude of flooding. The availability of fill and/or suitable soil onsite will reduce the construction cost significantly. If backwater flooding or seepage is a problem, then special structures must be included in the construction plan. Regular annual inspection for evidence of bank caving, bank sloughing, erosion, and foundation settlement will also increase associated costs.

Construction of a single floodwall will cost approximately $3/yd^3 for delivery, spreading, shaping, and compacting of the floodwall construction material. An additional $30/yd^3 will be required for delivery and placing of stone rip rap. If diversion ditches are required they may cost from $10 to $100 per foot depending on whether the ditch is lined.

SECTION 6

SITE CHARACTERIZATION/FIELD DATA REQUIREMENTS

Field data required for the evaluation and selection of appropriate corrective measures to be used at the Singer Furniture Company's Miller Hill Complex will be collected during the RFI. The objective of the RFI will be to characterize the nature and extent of contamination at the SWMUs under investigation at the Singer facility. Samples from each SWMU will be taken to determine the hazardous constituents present and the extent of their impacts. In addition to characterizing the hazardous constituent compounds present at the SWMUs, other physical aspects of the site must be characterized. This section describes the overall process of conducting site characterizations and then provides specific data needs for each of the remediation technologies discussed in Section 5.

6.1 Site Characterization

An important step prior to determination of proper corrective measures is site characterization. How detailed the characterization should be depends on the extent of the contamination and the amount of data required for the planning and implementation of an adequate response action. The amount of information and data collected during site characterization efforts is related to the complexity of the situation and of the selected corrective action response plan. A site evaluation should identify the nature and extent of contamination, the hydrogeologic characteristics, geographic and topographic characteristics, and water- and land-use patterns.

6.1.1 Nature and Extent of Contamination

An investigation into the nature and extent of contamination must be conducted in order to evaluate and select the appropriate corrective measures. The investigation may initially involve verification or suspected releases. If confirmed, further characterization of such releases will be necessary. This characterization includes identification of the type and concentration of hazardous waste or hazardous constituents released, the rate and direction at which the releases are migrating, and the distance over which releases have migrated. Inter-media transfer of releases (e.g., volatilization of hazardous constituents from contaminated soils to the air medium) may also be addressed, as appropriate.

6.1.2 Hydrogeologic Characteristics

A hydrogeologic characterization addresses both unsaturated (soil) and saturated (unconsolidated and consolidated) flow and contaminant transport conditions. It involves collection of information concerning the subsurface where the problem exits. Some of this information can be obtained from standardized regional and local reference sources; however, most of the needed data is site-specific and must be obtained by collecting soil, rock, water, and contaminant samples for chemical and physical testing in the laboratory or by conducting in-situ tests of hydrogeologic properties.

6.1.3 Geographic and Topographic Characteristics

An understanding of the general physical characteristics of a site is important. Surface attributes of a site should be identified because they can affect the subsurface environment both directly and indirectly. Climatic information (e.g., precipitation, temperature, and evapotranspiration) is also needed. Other factors having an impact on corrective actions are topography, accessibility, size of site, proximity to surface water, and proximity to population centers.

6.1.4 Water- and Land-Use Patterns

An understanding of surrounding water- and land-use patterns is essential to an assessment of the potential risk of affected populations. Current water usage and expected future requirements in the area of the release are important factors in determining the criticality of the threatened or polluted water resources.

6.2 Technology Specific Data Needs

Specific data requirements for evaluating each technology described in Section 5 are listed in Tables 6-1 through 6-14. Each table lists the various process data needs, why the are is required, and how it can be collected. The data needs presented in this section provide an organized list of information that may be required to be collected to adequately evaluate any of the technologies listed for use in remediating the Singer site.

TABLE 6-1. DATA NEEDS FOR EXCAVATION

Data Need	Purpose	Collection Method
Waste characteristics	Not suited for materials with a low solids content, may need to employ dewatering techniques	TSS analysis; TDS analysis; Leachate analysis; solid waste analysis
Nature and extent of contamination	Determines feasibility and cost-effectiveness	Sampling and analysis of surrounding areas
Topography	Accessibility to heavy equipment Run on, run off, flood control	Site survey; town/city/county records
Geologic characteristics	Difficulty of excavation Dewatering requirements	Geologic maps; borings, logs
Climate	Stability determination	Laboratory and field analysis
Soil characteristics Gradation, atterberg limits, % moisture, permeability, compactability	Stability determination	Laboratory and field analyses
Land use	Backfilling requirements	Interviews

TABLE 6-2. DATA NEEDS FOR CAPPING

Data Need	Purpose	Collection Method
Extent of contamination	Cost-effectiveness of cap versus excavation/removal	Sampling and analysis, site investigation
Depth to ground water table	May not be effective in areas with a high ground water table	Geologic maps, observation wells, boreholes, logs, geologic survey, piezometers
Availability of cover materials	Implementability and cost	Site inspection, site investigation
Soil characteristics - Gradation - Atterberg limits - %-Moisture - Compaction - Permeability - Strength	Suitability for use in cover	- Sieve analysis - Plasticity test - Volume-wt analysis - Proctor compaction - Triaxial permeameter - Triaxial shear, direct shear
Climate (precipitation)	Expected infiltration rate; design criteria	U.S. NDAA records; local records
Land use	Selection of proper cap design	Site investigation, site inspection, interviews

TABLE 6-3. DATA NEEDS FOR SOIL VAPOR EXTRACTION

Data Need	Purpose	Collection Method
Subsurface geology	Difficult installation with rocky strata	Geologic maps; boreholes, logs
Depth to ground water	Selection of drilling depth for extraction wells	Geological maps; logs, Piezometers, observation boreholes
Soil permeability	Effectiveness limited with low permeability soils	Triaxial permeameter
Waste constituents	Selection of appropriate well spacing and appropriate subsurface gas control technology	Sampling and analysis
Moisture content of waste and soil	Well-spacing	Volume-weight analysis
Percent compaction of waste	Well-spacing	Proctor compaction
Soil grain site distribution	Well-spacing	Sieve analysis

TABLE 6-4. DATA NEEDS FOR BIOSTIMULATION

Data Need	Purpose	Collection Method
Gross organic components (BOD, TOC)	Waste strength treatment duration	BOD_5 test; TOC analyzer
Waste constituents	Identify refractory and biodegradable compounds, toxic impact	Sampling and analysis
Microbiology cell enumerations	Determine existence of dominant bacteria	Bacterial aerobic heterotrophic plate counts
Temperature	Feasibility in climate	In-situ water quality monitoring
Dissolved oxygen	Rate of reaction	D.O. meter
pH	Bacteria preference	pH meter
Nutrient analysis NH_3, NO_3, PO_4, etc.	Nutrient requirements	Field test kits Lab analysis

TABLE 6-5. DATA NEEDS FOR SOLIDIFICATION/STABILIZATION

Data Need	Purpose	Collection Method
Soil properties	Compatibility with solidification agent	Soil sampling and analysis
Waste characteristics constituents, pH, TOC, etc.	Selection of appropriate solidification agent	Sampling and analysis
Climate	May be a loss of stability with several freeze/thaw cycles	National Climatic Center (NCC), local weather bureau

TABLE 6-6. DATA NEEDS FOR GROUND WATER PUMPING WELLS

Data Need	Purpose	Collection Method
Depth of aquifer	Selection of appropriate well system	Geologic maps, observation wells, boreholes, logs, piezometers
Depth to bedrock (impermeable strata)	Effectiveness of GW pumping	Geologic maps, logs, boreholes
Aquifer transmissivity	GW pumping systems perform poorly with low transmissivity	Pump tests, injection tests, local records
Aquifer storativity	Indicates degree of confinement; selection of appropriate well system	Pump test, injection tests, local records
Hydraulic conductivity	High conductivity preferred for most well systems, except ejector systems which perform best with low conductivity	Piezometer readings, pump tests
Geology	Fracture patterns must be traced in detail to ensure proper well placement	Geologic maps, logs, surveys, test trench, boreholes
Water solubility of contaminants	Perform best when contaminants are miscible and move readily with water	Sampling and analysis; CRC Handbook of Chemistry and Physics
Soil type	Suitability for pumping	Plasticity tests
Soil grain size distribution	Suitability for pumping	Sieve analysis

TABLE 6-7. DATA NEEDS FOR INTERCEPTOR TRENCH

Data Need	Purpose	Collection Method
Depth to impermeable strata (bedrock)	Trench spacing and feasibility	Geologic maps; logs; boreholes
Subsurface geology	Non cost-effective if substantial hard rock excavation is necessary	Geologic maps, boreholes, logs
Soil permeability	Trench spacing and inflow; not suited for soils with high permeability	Triaxial permeameter
Depth to water table	Trench spacing	Geologic maps; observation wells; boreholes; logs; piezometers
Ground water and leachate chemistry	Selection of pipe material (compatibility)	GW sampling and analysis
Drainage area of pipes	Inflow to pipe	Site visit/inspection; site investigation; topography map

TABLE 6-8. DATA NEEDS FOR SLURRY WALLS

Data Need	Purpose	Collection Method
Accessibility of site materials	Cost, implementability	Site inspection
Topography	Soil-bentonite walls require larger land area, relatively flat topography	USGS topography map; site investigation; site survey
Depth to impermeable strata	Cost, implementability	Borings
Seismic history	Cement-bentonite wall not applicable in areas subject to seismic activity	USGS geologic maps, records, field survey, aerial photos
Heterogeneity of subsurface formation	Difficult to install diaphragm wall with rocky subsurface material	Test trench, geologic maps.
Soil conditions	Suitability for backfill	Plasticity, size, permeability tests
Ground water depth, rate and direction of flow	Implementability	Existing geologic maps, boreholes, observation wells, logging and mapping piezometers
Soil chemistry	Cement-bentonite wall unsuited for highly acidic or high sodium soil	Soil sampling and analysis
Chemistry of waste and ground water	Compatibility with wall material	GW sampling and analysis

TABLE 6-9. DATA NEEDS FOR SHEET PILINGS

Data Need	Purpose	Collection Method
Depth to bedrock (impermeable strata)	Optimal wall depth	Geologic maps, boreholes, logs
Grain size distribution	Fine- to medium-grained soil particles optimum filling sheet pile joints	Sieve analysis
Compaction	Penetration resistance affects feasibility	Proctor compaction
Depth to ground water table	Maximum depth to which sheet piles can be effectively driven is approximately 15 feet	Geologic maps, observation wells, boreholes, logs, geologic survey, piezometers
pH of ground water and waste	Sheet pile lifetime (neutral pH is best)	Sampling and analysis
Leachate/ground water chemistry	Compatibility with sheet pile wall	Sampling and analysis

TABLE 6-10. DATA NEEDS FOR AIR STRIPPING

Data Need	Purpose	Collection Method
Gross organic components	Suitability for treatment	Sampling and analysis
Specific organic components	Suitability for treatment	Organic pollutant scan
Leachate or ground water analysis	Gas flow efficiency	Sampling and analysis
Column packing	Calculation of pressure drop	Manufacturer's data
Process size	Calculation of necessary column length	Capacities of processes producing wastes
Effluent requirements	Design criteria	Regulatory assessment

TABLE 6-11. DATA NEEDS FOR CARBON ADSORPTION

Data Need	Purpose	Collection Method
Biological organisms in leachate or ground water	Can aid in treatment through biodegradation, or can hinder operation via clogging or odor generation	Sampling and analysis
Leachate or ground water TSS concentration	Should not exceed 50 ppm; may need pretreatment	TSS analysis
Leachate or ground water oil and grease concentration	Should not exceed 10 ppm; may need pretreatment	Oil and grease analysis
Leachate or ground water components, and characteristics	Treatability via carbon adsorption	GC/MS analysis

TABLE 6-12. DATA NEEDS FOR ION EXCHANGE

Data Need	Purpose	Collection Method
Leachate or ground water characteristics	Resin selection	Sampling and analysis
TDS concentration	TDS should be 2,500 mg/l for efficient operation	TDS
TSS concentration	Suspended solids clog resin	TSS analysis
Treatability study	Flow through rate and resin regeneration frequency	Laboratory scale trial

TABLE 6-13. DATA NEEDS FOR PRECIPITATION

Data Need	Purpose	Collection Method
Variations in daily wastewater flow rate	Implementability; precipitation is inefficient with highly variable flow rates	Flow monitoring; stream gauging
Wastewater characteristics	Reagent requirements, precipitable constituents, interfering species, sludge production rate	Sampling and analysis, GC/MS
pH of wastewater	Reagent requirement and reaction success	Sampling and analysis
Settling rate	Sedimentation tank size	Laboratory analysis, Imhoff cone test

TABLE 6-14. DATA NEEDS FOR LEVEES AND FLOODWALLS

Data Need	Purpose	Collection Method
100-year floodplain elevation and floodway characteristics	Cannot be constructed in the FEMA-designated floodway	Topography map; FEMA flood study; USDA records
Site map	Levees require large land areas; floodwalls can be used in areas with limited space	Site inspection; site survey; town/city/county records
Flow patterns and velocity	Reduced flow storage capacity increases potential for downstream flooding	Gauge stations; meters; USDA records; field measurements
Soil type	Fine-grained clays or compacted sand and gravel for levees	Sampling and sieve analysis; plasticity tests
Soil permeability	Low permeability soils for levees	Triaxial permeameter
Topography	Additional drainage structures may be required in areas with steeper slopes	Topography map; site inspection site survey
Geologic characteristics	Bedrock suitable for sheet-pile cut-off is preferable	Existing geological maps, surveys; borehole logs

SECTION 7

RCRA CORRECTIVE MEASURES STUDY

Once a list of remedial action alternatives has been developed to deal with all site problems, these alternatives undergo screening to eliminate those that are an order of magnitude more costly than other alternatives and/or provide inadequate public health protection or have adverse environmental impacts which preclude their use. Only alternatives that satisfy the remedial response objectives and contribute substantially to the protection of public health, welfare, and the environment should be considered further. Figure 7-1 is a flowchart showing the remediation technology screening process.

Those alternatives remaining after the screening are then subject to detailed evaluation. The objective of this detailed analysis is to provide a level of evaluation to support the selection of the most cost-effective alternative. The detailed evaluation is submitted as part of the RCRA Corrective Measures Study (CMS).

As stated in the July 27, 1990 Federal Register on Corrective Action for SWMUs at Hazardous Waste Facilities, EPA anticipates that for most RCRA facilities, the studies needed for developing sound, environmentally protective remedies can be relatively straightforward, and may not require extensive evaluation of a number of remedial alternatives. Such "streamlined" CMS's can be tailored to fit the complexity and scope of the remedial situation presented by the facility. For example, if the environmental problem at a facility were limited to a small area of soils with low-level contamination, the CMS might be limited to a single treatment approach that is known to be effective for such types of contamination. In a different situation, such as with a large municipal-type landfill, it may be obvious that the source control element of the CMS should be focused on containment options.

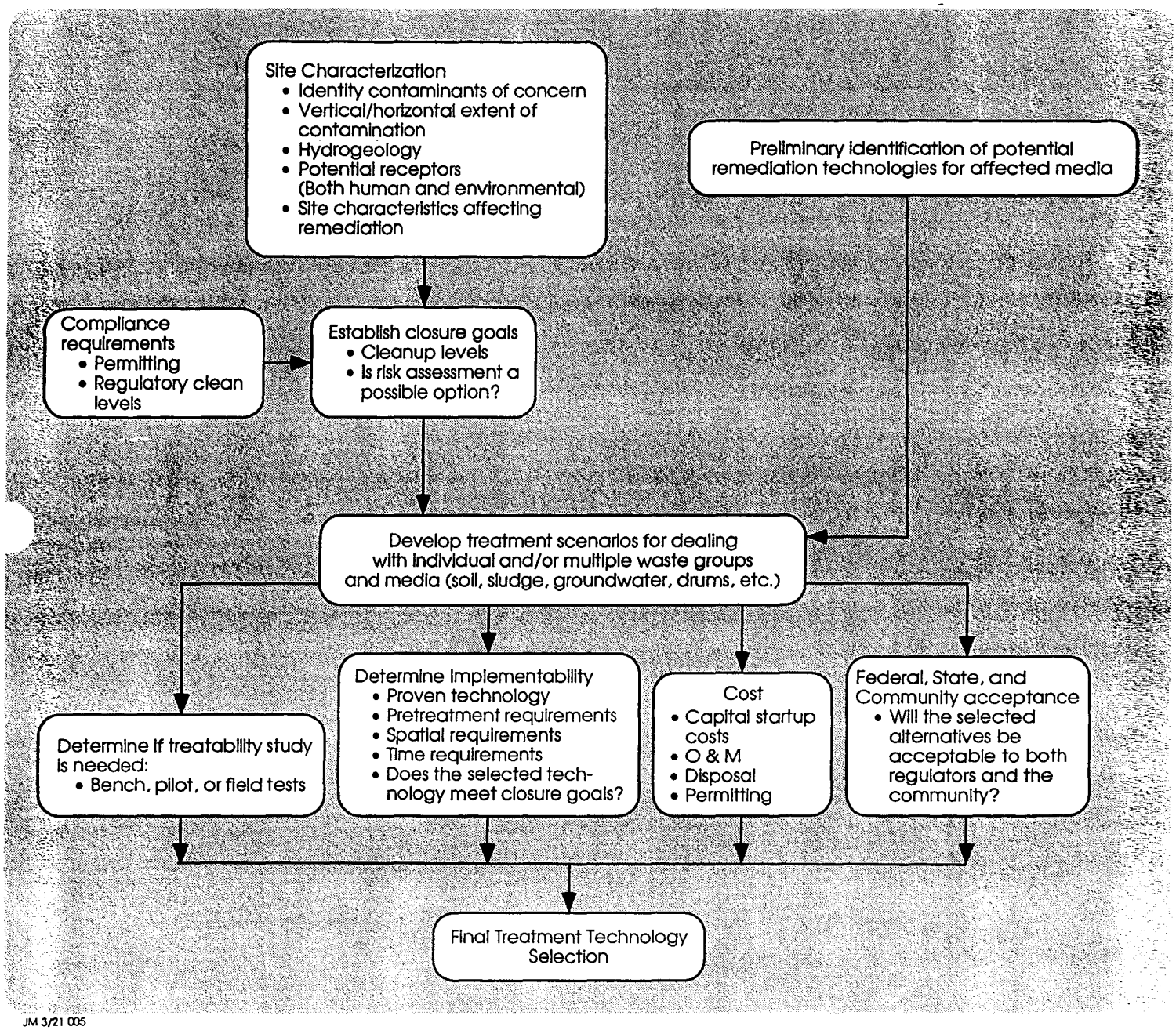

Figure 7-1. Remediation Technology Screening Guide Flowchart

As stated in proposed 40 CFR 264.525(a), technologies considered under corrective action must:

- Be protective of human health and the environment
- Attain media cleanup standards
- Control the sources of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment
- Comply with all applicable standards for management of wastes.

These standards reflect the major technical components of remedies: cleanup of releases, source control, and management of wastes that are generated by remedial activities. The first standard - protection of human health and the environment - is a general mandate derived from the RCRA statute. This standard requires remedies to include those measures that are needed to be protective, but are not directly related to media cleanup, source control, or management of wastes. An example would be a requirement to provide alternative drinking water supplies in order to prevent exposures to releases from an aquifer used for drinking water. Another example would be a requirement for the construction of barriers or for other controls to prevent harm arising from direct contact with waste management units.

Remedies will be required to attain the media cleanup standards that will be specified by EPA. The media cleanup standards for a remedy will often play a large role in determining the extent of and technical approaches to the remedy. In some cases, certain technical aspects of the remedy, such as the practical capabilities of remedial technologies, may influence to some degree the media cleanup standards that are established.

A critical objective of remedies must be to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. Unless sound control measures are taken, efforts to clean up releases may be ineffective or, at best, will involve an essentially perpetual cleanup situation. Effective source control actions are an important part of ensuring the long-term effectiveness and protectiveness of corrective actions at RCRA facilities.

The proposed source control standard is not intended to mandate a specific remedy or class of remedies. EPA encourages the examination of a wide range of remedies. This standard should not be interpreted to preclude the equal consideration of using other protective remedies to control the source, such as partial waste removal, capping, slurry walls, in-situ treatment/stabilization and consolidation.

There are general factors that are considered appropriate by EPA in selecting a remedy that meets the four standards for remedies, and that represent an appropriate combination of technical measures and management controls for addressing the environmental problems at the facility. The five general decision factors are:

- Long-term reliability and effectiveness
- Reduction of toxicity, mobility or volume of wastes
- Short-term effectiveness
- Implementability
- Cost.

The order of the decision factors listed above is not intended to establish an implicit ranking, nor does it suggest the relative importance each factor might have at any particular facility or across facilities in general. There are circumstances in which any one of these factors might receive particular weight.

For example, long-term effectiveness may rule out alternative remedies that might achieve clean up targets in the short-term, but at the expense of creating new or greater further risks that may necessitate a future corrective action. Conversely, remedies that significantly reduce actual or imminent human exposure in the short-term may be preferred over alternatives that eliminate long-term risks, but at the cost of lengthening the period during which exposure persists. Reductions in toxicity, mobility, or volume are especially valuable in situations where the wastes or constituents may degrade into more hazardous or toxic products, or fail to naturally attenuate. Finally, costs may be determinative when more than one alternative remedy can reach the established cleanup target. In practice, the relative weights assigned to these five factors will vary from facility to facility according to site characteristics.

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PHASE I

Oct. 82

J. E. SHIRINE COMPANY

CHITECTS ENGINEERS PLANN

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DRAFT

Mr. Richard J. McDonald
Singer Furniture
Post Office Box 1588
Lenoir, North Carolina 28645

Subject: Landfill Investigation
Report (Phase I)
Singer Furniture
Lenoir, North Carolina
Sirrine Job No. S-2148

Dear Mr. McDonald:

As requested by Singer Furniture, we have prepared this Landfill Investigation Report (Phase I) concerning the site near Plant No. 3.

We are available to discuss this report with you and appreciate the opportunity of preparing it.

Very truly yours,

J. E. SIRRINE COMPANY

Jim Brooks

J. R. Brooks

/sb

Enclosure

J.E. Sirrine Company
Post Office Box 5456, Greenville, South Carolina 29606
Telephone (803)298-6000

Landfill Investigation
Singer Furniture
Lenoir, North Carolina
Sirrine Job No. S-2148

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Landfill Investigation
Singer Furniture
Lenoir, North Carolina
Sirrine Job No. S-2148

A. INTRODUCTION

At the request of Singer Furniture, J. E. Sirrine Company was retained to technically evaluate the environmental condition of a closed waste disposal site on the property of Plant No. 3 at Lenoir, North Carolina.

There are no written records of the wastes or quantities of wastes which have been disposed at this landfill. However, municipal and industrial waste have been disposed because ownership of the property has proceeded from the City of Lenoir in the 1950's, to Magnavox in the 1960's, and Singer Furniture to the present. J. E. Sirrine Company was retained by Singer Furniture to coordinate a subsurface investigation of the site. As a result, Soil & Material Engineers was retained to perform the subsurface investigation and Enwright Laboratories was retained to perform the analytical portion of the project. The Soil & Material Report is included as Appendix 1. The analytical data, performed by Enwright Laboratories and the Spectrix Corporation, is presented in Appendix 2.

This study was intended to be a preliminary investigation to determine: if material is leaching from the landfill as a result of groundwater percolation and movement; if the groundwater down-gradient of the site contains constituents classified by the Environmental Protection Agency as priority pollutants; and if potentially hazardous constituents exist in the groundwater in concentrations which might present an endangerment to the public, aquatic or terrestrial life, or the environment.

A. INTRODUCTION - continued

The investigation was limited in scope and was intended to serve as an indicator of a possible problem with groundwater contamination. Per the results of this investigation, it was proposed that more intensive study be accomplished if a significant groundwater problem was indicated. This report contains recommendations concerning additional subsurface investigation and maintenance of the landfill.

B. SUMMARY

Singer Furniture disposed of certain wastes; organic solvents, varnish, lacquers, paints, and other chemicals associated with the production and finishing of furniture, in a landfill adjacent to Plant No. 3 in Lenoir, North Carolina. Singer Furniture utilized the site for waste disposal generally during the period 1972 - 1978. Prior to this period, Magnavox utilized the site during the 1960's, and the City of Lenoir used the site for municipal refuse disposal in the late 1950's. Ownership of the site has changed and, as a result, there is no record of the quantities or types of materials disposed. Relative to Singer Furniture, however, it is known that the materials listed above were disposed in the landfill. A portion of the material was drumned and portions were either disposed in bulk or burned in pits.

A monitoring network of four wells was established to determine by analysis if groundwater has been impacted by leachate from the landfill. This study was not designed to determine the total extent of any groundwater impact. The objectives of the study were: to determine the possibility that groundwater beneath and adjacent to the site is being contaminated; to determine the depths to groundwater and the geologic materials adjacent to the landfill, and; to determine the hydrologic properties of the strata beneath and adjacent to the landfill.

Landfill Investigation
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B. SUMMARY - continued

The analysis of groundwater samples indicates that a certain volume of material has leached from the landfill. The total extent of the leachate plume is not known, but significant contamination was detected in only one well. This well (N-1) is located immediately below the north face of the landfill. Two organic solvents, toluene (166 ug/l) and ethylbenzene (55 ug/l) and, a plasticizer, Bis (2-ethylhexyl) phthalate (100 ug/l), were detected. In addition, several metals were detected; most notably, chromium (400 ug/l), copper (650 ug/l), lead (600 ug/l), nickel (230 ug/l), zinc (1,100 ug/l), barium (6,100 ug/l), arsenic (93 ug/l), and beryllium (56 ug/l). The concentrations of chromium, lead, barium, and arsenic are above the Primary Drinking Water Standards. The complete analytical data is presented in Appendix 2.

The complete Hydrogeologic Investigation, as performed by Soil & Material Engineers, is presented in Appendix 1. In summary, this study concluded that groundwater beneath the landfill is moving in a general northwesterly direction toward the predominant area drainage feature (Lower Creek), a distance of approximately 600 -800 feet from the landfill.

The general geologic cross-section of the area beneath and down-grade of the landfill consists of: an upper alluvium of fine-grained silty clays and clayey silts approximately 10-20 feet thick; a lower alluvium of

B. SUMMARY - continued

coarser more permeable material approximately 15-30 feet thick; a saprolite zone of highly weathered feldspathic rock fragments, coarse quartz grains, biotite, and clay; and bedrock.

From soil testing, the radial permeability (K) and vertical permeability (K') were estimated. This data indicates that the lower alluvium is by far the most permeable strata. The less permeable weathered saprolite zone underlying the lower alluvium tends to retard vertical percolation and create more radial flow lines through the lower alluvium to any discharge point. Therefore, deep groundwater flow paths will not likely develop beneath and just downgrade of the landfill due to the short distance to the discharge area (Lower Creek) and the potential of the less permeable saprolite to deflect the water bearing lower alluvium in a horizontal direction.

Soil test information allowed the following permeabilities to be estimated:

Strata	Radial Permeability	Vertical Permeability
Upper Alluvium	0.3 ft/day	6×10^{-4} ft/day
Lower Alluvium	20 ft/day	_____
Saprolite	0.001 - 5 ft/day (typical range)	_____

The actual linear velocity of groundwater in the lower alluvium, considering the porosity of the soil and the hydraulic gradient, is estimated to be approximately 1 - 2 feet/day.

Landfill Investigation
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B. SUMMARY - continued

Considering the above information, it is the conclusion of Soil & Material Engineers that leachate slowly percolates through the upper alluvium due to the flow retarding properties of the clays in this strata. However, once penetration is made to the highly permeable lower alluvium, transport of contaminant material would proceed at a relatively high rate toward the discharge point (Lower Creek). However, it is not likely that the contaminant material would flow directly to Lower Creek. Contaminant material nearing Lower Creek would likely encounter floodplain flow lines which would transport the material in a downstream direction. Actual interception of the contaminants with Lower Creek may occur some distance downstream along a wide, dispered frontal plume.

Considering the real field data and postulating the above groundwater movement scheme, it is the opinion of J. E. Sirrine Company and Soils & Material Engineers that additional contaminant plume movement definition is warranted. This judgement considers that the lower alluvium is a potential, if not actual, large source of potable water. It is also a joint conclusion that the Human Resources Department of the North Carolina Department of Natural Resources and Community Development will arrive at a similar conclusion upon reviewing the hydrogeolgic and analytical data. Recommendations for additional work are made in this report.

C. RECOMMENDATIONS

The Soil & Material Engineers' Hydrogeologic Investigation determined that a high potential exists for contamination of the very permeable lower alluvium down-gradient of the landfill. The existing network of monitoring wells are adequately located for developing the initial groundwater monitoring program. However, no wells are located sufficiently down-gradient of the landfill in the Lower Creek floodplain to better define the extent of contaminant plume movement. It is, therefore, the recommendation of J. E. Sirrine Company and Soil & Material Engineers that two or three additional monitoring wells be installed in the Lower Creek floodplain northwest of the landfill to tap the lower alluvium strata. The water quality would be analyzed in each of the new wells as in Phase I. This recommendation considers that the permeable lower alluvium could transport material beyond the property boundaries of Singer Furniture and contaminate a potential large groundwater source.

General information has been obtained from the North Carolina Department of Natural Resources and Community Development regarding the existence of water wells in the general area of Plant No. 3. It is recommended that a systematic well survey, involving residential and industrial establishments, be performed. Although it is suspected that groundwater flow is generally toward Lower Creek, north and northwest, the well survey should include the area east of the landfill along Virginia Street as well as areas west and northwest adjacent to the floodplain.

C. RECOMMENDATIONS - continued

The landfill has been recently leveled and grassed. It has been noted that several small holes or pits are located in the landfill. In order to minimize the infiltration of rainfall and surface drainage, these surface depressions should be filled with impermeable soil. In addition, any future investigation should include testing of the soil overlying the landfill to estimate permeability. If the permeability is high, a possible remedial action may involve covering the landfill with a layer of low permeable clay.

The above recommendations are presented as criteria for further study. These recommendations do not represent a proposal for additional investigation, but are presented as a basis for future work. A specific work plan denoting the exact number of wells, soil testing, water quality data, etc., and the costs involved will be formulated at the request of Singer Furniture.

D. LANDFILL CONDITIONS

1. The Surrounding Site

Singer Furniture Plant No. 3 is located in Lenoir, North Carolina near the intersection of Morganton Boulevard (Highway 18) and Virginia Street (also known as Miller Hill Road) (Figure 1.). Plant No. 3 is located on a side hill cut. From the production facility the land slopes moderately to the north toward Lower Creek.

The property is surrounded by relatively low density residential areas along Virginia Street to the east and southeast and along Fairview Drive to the west and southwest. Lower Creek, the predominant area drainage feature, is to the immediate north. Further north across Morganton Boulevard is a large industrial area. To the immediate south of Plant No. 3 is a heavily wooded hill which rises to a height almost eighty feet above the production facility.

The landfill is located to the immediate north of Plant No. 3. Downgrade of the landfill (from the northeast to the northwest) is the undeveloped floodplain of Lower Creek. Periodic floods in this valley area make it totally unusable for residential or commercial purposes. The floodplain is heavily vegetated with trees and undergrowth.

2. The Landfill

The landfill, which is approximately six acres, is located immediately

D. LANDFILL CONDITIONS - continued

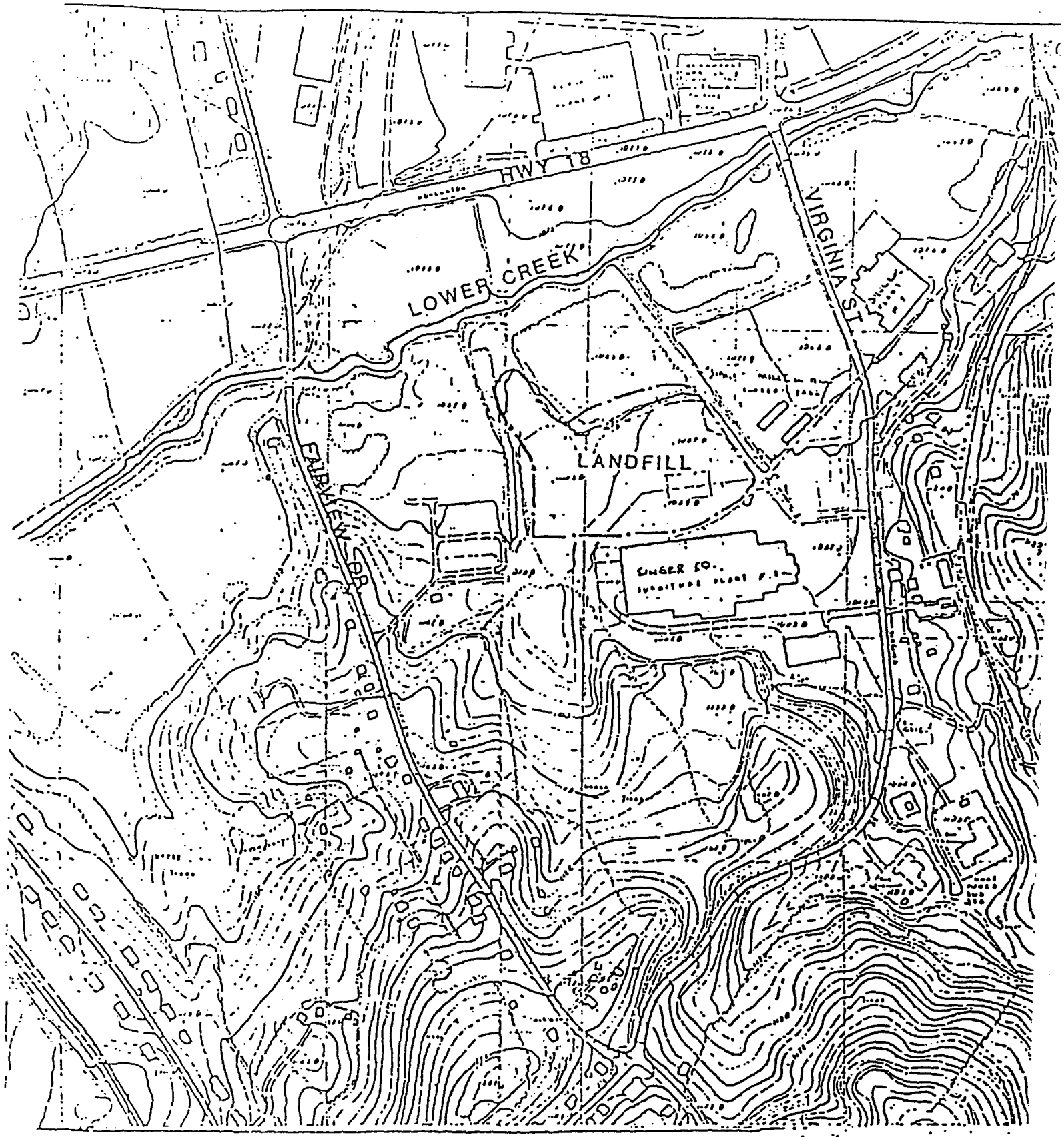
2. The Landfill - continued

north of Plant No. 3 and west of the facility lumber yard. The most recently filled area of the landfill extends to the outer limits of the Lower Creek floodplain (Figure 1.).

The precise boundaries of the landfill are not known. Initially, the City of Lenoir utilized the site for disposal of municipal refuse during a short period in the late 1950's. Municipal garbage and debris was encountered during the installation of monitoring well W-1B to a depth of fifteen feet. From this information it was concluded that garbage was disposed along the western portion of the site in a relatively narrow arm which extends to the 1075 contour interval at a minimum.

It was not the intent of this study to perform auger borings in the landfill to determine the exact extent of the disposal area or to identify the materials disposed. From what is known, however, it appears that the City of Lenoir may have utilized the western portion of the site and subsequent usage by Magnavox in the 1960's and Singer Furniture in the 1970's may be confined predominantly to the eastern section of the site.

During the 1970's Singer Furniture utilized the site for disposal of


HWY 18
LOWER CREEK
VIRGINIA ST.
LANDFILL
FAIRVIEW DR.
SCALE
200 0 200 400
CONTOUR INTERVA

D. LANDFILL CONDITIONS - continued

2. The Landfill - continued

certain industrial wastes, soil fill, and scrap metal. Unknown quantities of industrial wastes; including solvents, lacquers, varnish, glues, and paints were likely disposed in the landfill. A portion of this material was disposed in drums and a portion was burned in open pits in the landfill.

Since disposal activity ceased in the late 1970's, the landfill has been leveled and a uniform fill cover applied. In addition, the entire site has been grassed.

E. METHODS AND PROCEDURES

1. Monitoring Well Locations

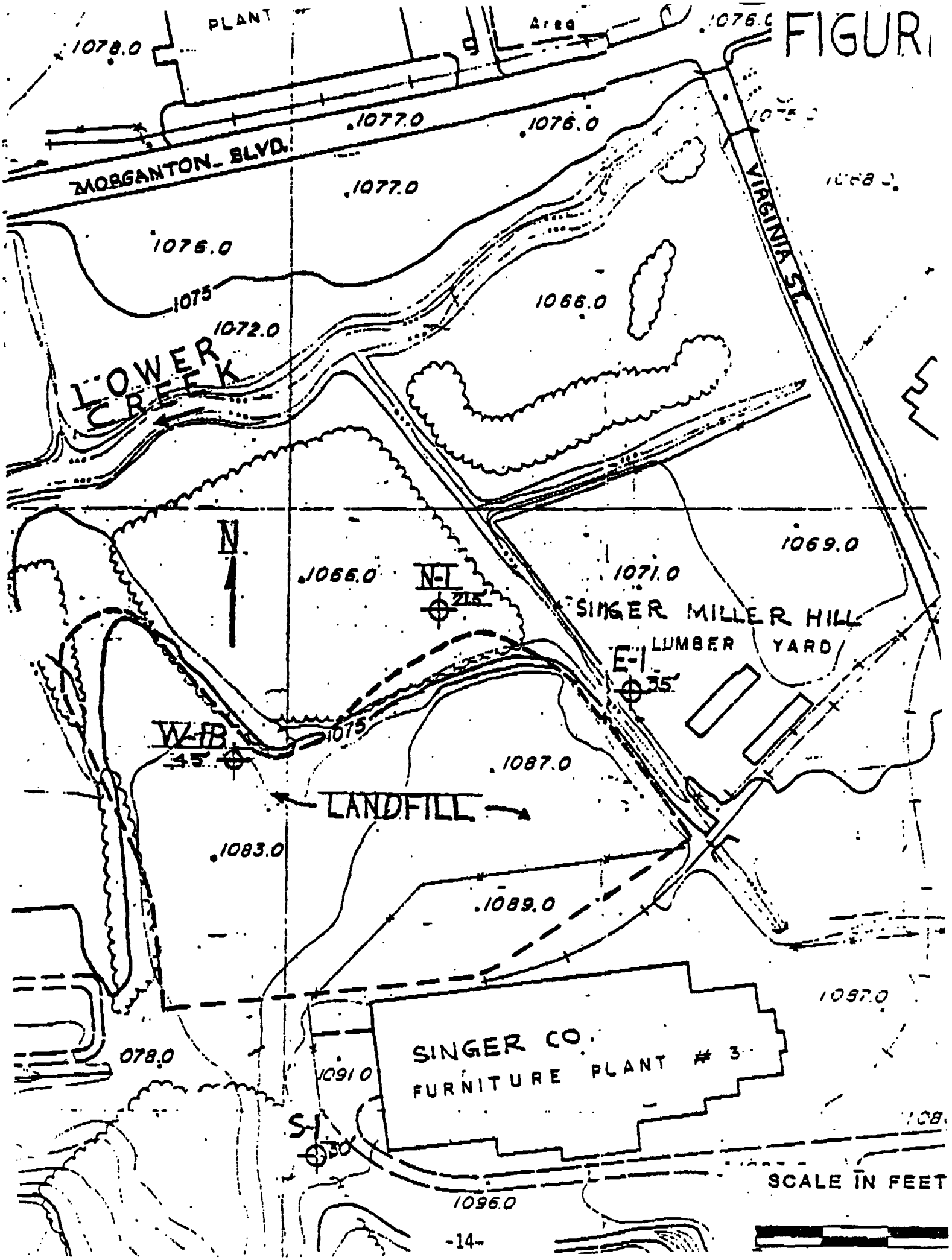
Upon a reconnaisance of the site, it was determined that a monitoring network of four wells would be sufficient to determine if a significant groundwater contamination problem exists. One monitoring well was located up-gradient of the landfill to serve as a background data point. Three wells were located down-gradient of the landfill after a careful consideration of the landfill extent and topographic information.

The monitoring wells, located on Figure 2., are listed below.

Monitoring Well	
S-1	Up-gradient, south of the landfill
E-1	Down-gradient, east of the landfill
N-1	Down-gradient, north of the landfill
W-1B	Down-gradient, northwest of the landfill (In Partial Fill)

Prior to the investigation, it was suspected that groundwater underlying the landfill flowed generally north and northwest toward the predominant drainage feature, Lower Creek. A Lower Creek feeder spring which heads between the landfill and the lumber yard, was also a possible flow direction for groundwater underlying the extreme eastern edge of the landfill. Therfore, well E-1 was located adjacent to the

FIGUR


PLANT
Area
1078.0
1076.0
1077.0
1076.0
MORGANTON BLVD.
1077.0
VIRGINIA ST.
1076.0
1075
1066.0
1072.0
LOWER CREEK
N
1066.0
N-1
21.5'
1071.0
1069.0
SINGER MILLER HILL
LUMBER YARD
E-1
35'
W-1B
45'
1075
1087.0
LANDFILL
1083.0
1089.0
1087.0
SINGER CO.
FURNITURE PLANT # 3
1078.0
1091.0
S-1
30'
1096.0
SCALE IN FEET

E. METHODS AND PROCEDURES - continued

1. Monitoring Well Locations - continued

spring to detect possible contamination moving in this direction. Because the spring is very small, it is not thought that it forms a complete barrier if groundwater is moving in this direction. Therefore, E-1 was located just east of the spring. The steep east landfill face prevented locating a well between the landfill and the spring.

Well N-1 was located down-gradient of the north face of the landfill. This well is ideally located to detect leachate from the eastern half of the landfill. That portion of the landfill is suspected of containing much of the disposed industrial wastes.

A second small spring heads west of the landfill and flows a short distance to Lower Creek. It was intended to locate a well down-gradient of the landfill between the fill and the spring because this is a possible groundwater flow direction. Well W-1A was abandoned when municipal refuse was encountered. Well W-1B was an attempt to move down-gradient of the fill. Municipal fill material was again encountered. The suspected extent of this narrow arm of the fill and the dense vegetation in this area prevented further relocation of this well to the northwest. This well, and the other three, was sealed with bentonite above the screen to prevent contamination from the landfill material.

E. METHODS AND PROCEDURES - continued

1. Monitoring Well Locations - continued

The monitoring wells were installed October 12-13, 1982. The installation information, i.e., well depths, groundwater levels, soils information, etc., is contained in Soil & Material Engineers' Hydrogeologic Investigation (Appendix 1.).

2. Monitoring Well Installation

The well holes were advanced utilizing a drilling with a rotary head and conventional hollow-stem augers. The augered holes were approximately five inches in diameter and the wells were installed using two-inch PVC piping. Wells screens were typically five feet in length, except ten feet at N-1. A six-inch steel outer casing covered the PVC stick-up at all well locations. The steel casing contained a locking cap.

A typical monitoring well cross-section is shown in Soil & Material Engineers' Hydrogeologic Investigation (Appendix 1.). With the exception of approved variances, the well installations meet the specifications required by the North Carolina Department of Environmental Management.

3. Monitoring Well Sampling

The monitoring wells were installed October 12-13, 1982. The wells were

E. METHODS AND PROCEDURES - continued

3. Monitoring Well Sampling - continued

allowed to stabilize and on October 19, 1982, the wells were bailed per standard procedures to remove a minimum of three times the well volume. The purpose of the bailing was to remove impurities that may have resulted from augering the well holes, the PVC pipe used for well casing, or the quick-drying glue used to cement the PVC pipe connections. The wells were bailed by repeatedly purging the contents of a six-foot sampling tube with nitrogen gas. The six-foot sampling tube was equipped with a foot valve which allowed bailing to near the bottom of the well.

Each of the monitoring wells was sampled on October 20, 1982, for water quality analysis. Samples were taken from the wells using the same six-foot PVC sampling tube used for bailing. Extreme care was taken to avoid cross-contamination of groundwater samples by cleaning the sampling tube between each well sampling. Upon raising the sampling tube to the surface, the samples for each well were transferred to a compositing container. When a sufficient volume of sample had been composited for each well, the sample was immediately transferred to several individual containers that contained the various preservatives for the particular analyses to be performed. The samples were placed in insulated containers with ice and shipped

E. METHODS AND PROCEDURES - continued

3. Monitoring Well Sampling - continued

to Spectrix Laboratories, Houston, Texas, by overnight courier. Certain analyses were performed by Enwright Laboratories of Greenville, South Carolina.

A definitive list of compounds which were disposed in the landfill could not be formulated. Therefore, as an initial effort, a wide range of compounds was analyzed. These included those chemicals listed by the Environmental Protection Agency as Priority Pollutants, certain heavy metals, certain herbicides, phenols, and other miscellaneous constituents. The complete analytical data, as performed by Spectrix Laboratories and Enwright Laboratories, is contained in Appendix 2.

F. MONITORING WELL SAMPLING RESULTS

Groundwater samples were taken from the four monitoring wells on October 20, 1982. Spectrix Laboratory of Houston, Texas, performed the organic priority pollutant analysis and Enwright Laboratories of Greenville, South Carolina performed the analysis for metals, cyanide, phenols, dissolved organic carbon, chloride, nitrate, and sulfate.

Most of the priority pollutants analyzed were below the minimum level of detection. However, four organic priority pollutants were detected in the groundwater samples and several metals were detected at one location in concentrations near or greater than the Federal Primary Drinking Water Standards.

The organic priority pollutants detected are listed below:

Monitoring Well	Location	Constituent	Concentration (ug/l)	Detect Limi (ug/l
S-1	Up-grade of landfill	No Organics		
W-1B	Down-grade of landfill (In Partial Fill)	No Organics		
E-1	Down-grade of landfill	Methylene Chloride	30	10
N-1	Down-grade of landfill	Ethylbenzene	55	10
		Toluene	166	10
		Bis (2-ethylhexyl) Phthalate	100	10

The concentrations of the detected organics are relatively low; however these constituents are listed as priority pollutants based on their hazard potential.

Landfill Investigation
Singer Furniture
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F. MONITORING WELL SAMPLING RESULTS - continued

The compounds detected and their general industrial uses are discussed below.

Methylene chloride (Dichloromethane) - A volatile liquid, soluble in alcohol (only slightly in water), nonflammable and nonexplosive in air, highly toxic by inhalation of fumes, moderately toxic by ingestion and skin absorption. Primary uses: paint removers, solvent degreasing and cleaning, solvent for cellulose acetate, plastics processing.

Bis (2 ethylhexyl) phthalate, 1, 2 - Benzenedicarboxylic acid bis (2 - ethylhexyl) ester, (di 2 - ethylhexyl phthalate) - a liquid, miscible with mineral oil, insoluble in water, combustible. Primary uses: plasticizer, in vaccum pumps.

Ethylbenzene - A colorless liquid, soluble in alcohol, almost insoluble in water, flammable, moderately toxic by ingestion, inhalation, and skin absorption. Primary uses: solvent, intermediate in production of styrene.

Toluene - A colorless liquid, soluble in alcohol, insoluble in water, flammable, moderately toxic by ingestion, inhalation, and skin absorption. Primary uses: solvent for paints and coatings, gums, resins, most oils, rubber, vinyl organosols; diluent and thinner in certain lacquers; adhesive solvent in plastic items.

Landfill Investigation
Singer Furniture
Lenoir, North Carolina
Sirrine Job No. S-2148

F. MONITORING WELL SAMPLING RESULTS - continued

In addition to the priority pollutant organics, the following metals were detected at N-1. Metals were not detected in any of the other wells in concentrations greater than expected background levels.

N-1

Constituent	Concentration (ug/l)	Primary Drinking Water Standard (ug/l)
Antimony	1.0	No Standard
Arsenic	93	50
Beryllium	56	No Standard
Cadmium	6.8	10
Chromium	400	50
Copper	650	1000*
Lead	600	50
Mercury	0.2	2.0
Nickel	230	No Standard
Selenium	3.0	10
Silver	0.1	50
Thallium	0.1	No. Standard
Zinc	1,100	5000*
Barium	6,100	1000

* Secondary Drinking Water Standard

Several metals were detected in well N-1 at concentrations greater than expected background levels. The concentrations of arsenic, chromium, lead, and barium exceed the Primary Drinking Water Standards. In addition, the concentrations of copper, nickel, zinc, beryllium, and cadmium are much higher than found in the other three wells.

Landfill Investigation
Singer Furniture
Lenoir, North Carolina
Sirrine Job No. S-2148

F. MONITORING WELL SAMPLING RESULTS - continued

In addition to the metals, well N-1 contained the only significant organics detected in the monitoring network. Ethylbenzene, toluene, and Bis (2-ethylhexyl) phthalate were detected in relatively low concentrations. Methylene chloride was detected at a very low concentration in well E-1. Although methylene chloride has been used as an industrial solvent, it is also used in the analytical extraction of organic compounds. Therefore, at this low concentration, 30 ug/l, methylene chloride could have been introduced via analytical contamination.

The analysis of groundwater from the monitoring well network indicates that a certain amount of disposed material is leaching from the landfill. The contamination appears limited to well N-1. This may confirm the supposition that the bulk of the industrial wastes was deposited in the eastern half of the landfill. The organics detected at N-1, primarily toluene and ethylbenzene, could have been used as cleaning solvents or be associated with the paints, varnish, and lacquers used in the production of furniture. The metals detected at N-1 could have also resulted from paint pigments that were disposed in bulk.

SOIL & MATERIAL ENGINEERS INC. ENGINEERING-TESTING-INSPECTION

3025 McNaughton Drive, Columbia SC 29206, Phone (803) 788-6343

January 11, 1983

J. E. Sirrine Company, Inc.
Post Office Box 5456
216 South Pleasantburg Drive
Greenville, South Carolina 29606

Attention: Mr. Jim Brooks, P. E.
Project Manager

The Singer Company
Post Office Box 1588
Lenoir, North Carolina 28645

Attention: Mr. Richard J. McDonald

Subject: Hydrogeologic Investigation of the Closed Landfill Area
The Singer Company, Plant No. 3, Lenoir, North Carolina
S&ME Report No. 044-82-129

Gentlemen:

Soil & Material Engineers, Inc. is pleased to submit the above referenced report. This report presents the results of field and laboratory investigations; our conclusions concerning the physical hydrogeology of the site; and the source and potential occurrence and movement of contaminants; and recommendations concerning water-quality monitoring and additional investigation.

This report is submitted as a draft for your review and comment. Should you have any questions or comments concerning the content or style, we would be pleased to receive them. A final report will be issued after your reveiw and approval.

We appreciate this opportunity to be of service to the J. E. Sirrine Company, Inc. and The Singer Company. If there are any questions concerning our report or study, we would be pleased to personally discuss the report and any aspects of the study at your convenience.

Respectfully submitted,
SOIL & MATERIAL ENGINEERS, INC.

Curtis L. Gorman
Project Geologist

B. C. Spigner, RPG
Senior Hydrogeologist

HYDROGEOLOGIC INVESTIGATION
of the
CLOSED LANDFILL AREA
THE SINGER COMPANY
PLANT NO. 3

for

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Greenville, South Carolina

and

The Singer Company
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Lenoir, North Carolina

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SOIL & MATERIAL ENGINEERS, INC.

Report No. 04482-129

January 11, 1983

HYDROGEOLOGIC INVESTIGATION
OF THE
CLOSED LANDFILL AREA
THE SINGER COMPANY
PLANT NO. 3

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ILLUSTRATIONS AND TABLES

(All figures and tables are in Appendix A)

FIGURE

1 Topographic Map of the Landfill Site and Vicinity

2 Site Map Showing Monitor Well Locations and Cross-Section Lines

3 Generalized Geologic Cross-Section A-A', South to North

4 Generalized Geologic Cross-Section B-B', West to East

5 Generalized Map of Ground-Water Flow within Unit IB

6 Well Construction Schematic of Typical Monitor Well

TABLE

1 Test Hole and Well Construction Data

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3 Summary of Physical Laboratory Tests

4 Summary of Water Level Data

5 Summary of Borehole Permeability Tests

APPENDICES

A. Illustrations and Tables

B. Soil Boring and Well Records

C. Grain-Size Distribution Curves

SECTION 1.0 INTRODUCTION

1.1. PROJECT BACKGROUND

In September, 1982 Soil & Material Engineers, Inc. (S&ME) was retained by the Singer Company through J.E. Sirrine Company to make a hydrogeologic assessment of the closed landfill at Singer Furniture Plant No.3, Lenoir, N.C. (fig.2). The objectives of this assessment were outlined in S&ME Proposal No. P4482-1046, dated September 1, 1982.

1. Install a ground-water monitoring system that will meet State regulatory requirements.

2. Make a hydrogeologic assessment of the landfill area to (1) determine the possibility that ground water beneath and adjacent to the site is being contaminated, (2) determine the depths to ground water and the types of geologic materials immediately adjacent to the landfill, and (3) determine the hydrologic properties of geologic strata beneath and immediately adjacent to the landfill.

1.2 DESCRIPTION OF THE LANDFILL AREA

The site of the investigation includes the general area shown on figure 2. The principal facilities located at Singer Furniture Plant No. 3 include the closed landfill area, the main plant building located immediately south of the landfill, and the lumber yard, located immediately east of the landfill.

The landfill area was previously owned by the City of Lenoir and was used as a municipal disposal site in the late 1950's for about 3 years. The landfill was then used by the Magnavox Company until it was sold to the Singer Company in the early 1970's. The Singer Company disposed waste products in the landfill until the late 1970's. Therefore, the landfill contains various waste materials which include municipal refuse, industrial wastes, and rock and soil fill. Information provided by the Plant Engineer indicates that the

wastes may include: toluene; acetone; methanol; various organic solvents; resin glues; and ezylene and lead from pigments. Finishing products may include lacquer, staining chemicals and paints that were probably disposed in hard form. Liquids from wash-down were previously burned, dumped or containerized until recovery operations were initiated around 1977. Scrap had been disposed in the landfill up to 1981.

The contents of the landfill were leveled during the last 4 years, and a wood shed was constructed on the landfill refuse near the southern margin of the landfill (fig.2). The shed is presently used primarily as a vehicle-maintenance garage.

The surface of the landfill slopes gently to the north, where it drops off abruptly near the northern margin. A thin layer of landfill material extends beyond monitor well W-1. The western edge of the landfill material extends beyond well W-1B, probably to the 1075 ft mean sea level (msl) contour (fig.2). The eastern perimeter of the landfill extends to the ditch adjacent to the lumber yard. The southern portion of the landfill overlies excavated fill material upon which Plant No. 3 is located.

The surface of the landfill is presently vegetated; a thin layer of soil covers the landfill, but small depressions occur in the surface of the landfill which allow surface runoff to percolate into the landfill.

SECTION 2.0 GEOLOGIC AND HYDROLOGIC SETTING

2.1 GENERAL GEOLOGY AND GROUND-WATER CONDITIONS

The Singer Plant No. 3 is located in the Inner Piedmont belt of the Piedmont geologic province. Rocks within the Inner Piedmont consist of Paleozoic age crystalline rocks which occur in northeast-trending belts. The plant is located in the valley of Lower Creek which flows to the southwest and empties into the upper reaches of the Catawba River.

As described by Goldsmith and others (1978), the bedrock in the vicinity of the site consists primarily of migmatite gneiss and garnet gneiss, with some biotite schist and gneiss also occurring. The bedrock is overlain by a variable thickness of residual soil called saprolite. In the valley of Lower Creek, alluvial desposits overlie saprolite or crystalline bedrock.

There are no current published reports that describe the specific hydrogeology of the area surrounding the plant. Information on the hydrogeology of the Lenoir area was obtained from Mr. Richard Peace of the N. C. Department of Natural Resources and Community Development (DNR). According to Mr. Peace, the hydrogeology of the Lenoir area is poorly known, and there have been no recently completed ground-water studies of this area.

The Singer Plant No. 3 and other industries in the immediate vicinity of the Plant purchase water from the City of Lenoir. A municipal water line is located along Virginia Street, and most of the residents east of the Plant are served by City water (Lenoir Water Works, personal communication). Therefore, there are apparently no private wells located in the immediate vicinity of the plant.

The elevation of the site ranges from approximately 1095 ft mean sea level (msl) at Plant No. 3, to 1065 ft msl in the flood plain just north of the landfill (figs. 1 and 2). The surface of the site slopes gently north to the edge of the landfill, where it abruptly drops in elevation from about

1085 ft msl to about 1066 ft msl on the flood plain surface.

Surface water from the site drains toward the ditch to the northeast between the landfill and the lumber yard; and to a draw west of the site. Both these intermittent drainage features drain toward the northwest to Lower Creek. The upper portion of the site is adequately drained. The flood plain area from the landfill northward to Lower Creek is a poorly drained wooded area, which is periodically flooded.

2.2 CLIMATE

Precipitation in the Lenoir area is fairly well distributed throughout the year. The greatest amount of precipitation generally occurs from early spring through early fall. The least generally occurs during the late fall and winter. The average annual rainfall for the Lenoir area is 49.94 inches. Departures from normal monthly precipitation commonly occur and mild droughts are common.

Precipitation is the source of ground-water recharge in the area. Therefore, variations in the quantity of precipitation will have an effect on the amount of recharge to the aquifers. During the two months prior to the field investigation (August and September), precipitation was 6 inches below normal. Therefore, ground-water levels measured during this investigation may have been lower than usual.

SECTION 3.0 METHODS OF INVESTIGATION

3.1 FIELD INVESTIGATION

Five test holes (N-1, E-1, W-1A, W-1B, and S-1) were drilled at the site. Four of these test holes were converted to monitor wells. The locations of these test holes are shown on figure 2, and information on these test holes is summarized in table 1.

Split-spoon samples were collected every 2.5 ft for the first 10 ft, where conditions while drilling in fill permitted, and at 5-ft intervals thereafter, to the total depth (TD) of each of the test holes. These samples were visually classified in the field, and later in the laboratory by the project geologist, and lithologic boring logs were prepared (see Soil Boring and Well Records - Appendix B). These lithologic logs were used in preparing geologic cross-sections of the site in order to define the subsurface stratigraphy and water-bearing character of the strata.

The locations and elevations of the test holes were estimated by measuring the distance from the test hole to a known reference point on a topographic map of the site supplied by The Singer Company. Therefore, land-surface and well elevations should be regarded as approximate.

Water levels were measured in the 4 wells on October 13, 1982 (table 4). Groundwater levels were measured with an electric drop-line and fiberglass tape to an accuracy estimated to be within 0.1 ft. These water levels were then converted to approximate mean sea level (msl) elevations.

Field borehole permeability tests were made on Wells W-1B, N-1, and E-1 in order to determine the radial permeability (hydraulic conductivity, K) of strata beneath the site. These test results are summarized in table 5 and are discussed in Section 4.0.

The 4 test holes at the site were converted to 2-in diameter wells as illustrated in figure 6. Wells W-1B, E-1, and S-1 have a 5-ft length of PVC screen with 0.025-in slots and Well N-1 has a 10-ft length of screen. Well construction data are summarized in tables 1 and 2.

A variance to the DNR requirements for well construction was granted by the Division of Environmental Management (DEM) in a letter dated October 5, 1982. Field conditions required modification of the approved well construction guidelines. The well construction modifications were approved by personal communication with DEM on October 11 and 12, 1982.

The drill rig and all well materials were pressure cleaned between wells to minimize potential cross-contamination. Monitor Well E-1 was developed with compressed air; and Wells N-1, S-1, and W-1B were developed with water to remove sediments, drilling fluid, and contaminants which may have entered the screen/well casing during drill and well construction. Down-gradient Wells N-1 and W-1B were not developed with air because poor weather conditions did not permit access to the wells by vehicle.

3.2 LABORATORY SOILS TESTING

Laboratory testing of soil samples collected in the field consisted of preparing lithologic logs (detailed descriptions) and performing 2 grain-size analyses. The lithologic logs (Appendix B) were prepared by the project geologist from his own field notes, the driller's field notes, and from his lithologic analyses of samples in the laboratory. The grain-size analyses were made on split-spoon samples from 2 test holes (W-1B, E-1) in order to characterize the physical properties of strata beneath the site. These analyses are summarized in table 3, and the grain-size distribution curves are presented in Appendix C.

SECTION 4.0 GEOLOGY AND GROUND-WATER CONDITIONS

4.1 STRATIGRAPHY

Geologic formations beneath the landfill area have been divided into 3 geologic units.

Alluvium (Unit I)--near-surface sediments of Quaternary age consisting of clays and silts and permeable fine-to coarse-grained sands.

Saprolite and Colluvium (Unit II)-- soil composed of decomposed bedrock (saprolite) and highly weathered bedrock and saprolite talus (colluvium).

Bedrock (Unit (III)-- metamorphic bedrock consisting of migmatite gneiss, garnet gneiss, and biotite schist and gneiss.

The general stratigraphic relationships, lithology, thickness, and hydrologic characteristics of these units are illustrated on figure 3.

4.1.1 Alluvium (Unit I)

The Alluvium (Unit I) has been subdivided into 2 hydrogeologic units on the basis of hydrologic properties-- the fine-grained Upper Alluvium (Unit IA), and the coarser-grained Lower Alluvium (Unit IB).

The Upper Alluvium (IA) consists primarily of a brown to grayish-black silty clay and clayey silt. Although this unit contains little sand in test holes W-1B and E-1, an interbedded lens of slightly silty sand occurs between the clay and silt beds in Well N-1. As illustrated in figure 4, Unit IA is 18 ft thick at Well W-1B, but thins to as little as 9 ft at Well N-1.

The Lower Alluvium (IB) consists of blue-grey to yellow-brown fine to coarse sand. At the boring locations, this unit becomes coarser-grained and contains less silt with increasing depth. As illustrated in figure 4, gravel occurs at the base of the unit at Wells W-1B and E-1. The top of Unit IB occurs at a

depth of 14 ft at Well N-1 and 33 ft at Well 1B. The total thickness of Unit IB is unknown because the test holes did not penetrate the full thickness of this unit. The maximum thickness penetrated is 20 ft at Well E-1 (fig.4).

4.1.2 Saprolite and Colluvium (Unit II)

Although saprolite was penetrated in only the up-gradient Well (S-1), it is reasonable to assume that it underlies the alluvium (Unit I) beneath the landfill. In Well S-1, saprolite was differentiated from colluvium primarily on the basis of density differences (blow-counts); because these 2 units are lithologically similar (see Boring Record in Appendix B). The saprolite occurs at a depth of 23.5 ft in Well S-1. The thickness of the saprolite is unknown because no boring penetrated the full thickness of the unit. Borehole samples from Well S-1 and exposures in the sand pit south of Plant No.3 indicate that the saprolite consists of layered bands of highly weathered feldspathic rock fragments, coarse quartz grains, biotite, and clay.

The colluvium originates from the downslope movement of highly decomposed bedrock and saprolite from the steep slope of the hill south of the plant, and is limited to this area. As illustrated in figure 3, colluvium overlies the saprolite in Well S-1 from a depth of approximately 8.5 ft to 23.5 ft.

4.2 GROUND-WATER OCCURRENCE AND WATER-BEARING PROPERTIES

4.2.1 Upper Alluvium (Unit IA)

Ground water occurs in very thin sands and silts in the Upper Alluvium (IA) under water-table conditions. The fine-grained sediments within this unit probably function as semi-confining beds because they are considerably less permeable than the sands in the Lower Alluvium (IB).

One grain-size analysis from Well W-1B and visual analysis of split-spoon samples were used to estimate the radial permeability (K) and vertical permeability (K') of Unit IA strata. The estimated radial permeability (K) of these strata ranges from less than 0.1 ft/day to about 5 ft/day. The higher K value is estimated for the thin sand lens which occurs in Well N-1 at a depth of 8-11.5 ft (fig.4). An average radial permeability for Unit IA is estimated to be about 0.3 ft/day because of the overall fine-grained texture of Unit IA strata. $.3\ ft/day \times 12''/ft \times 2.54\ cm/in \times 1.16 \times 10^{-5}\ days/sec = 1.064 \times 10^{-4}$

The vertical permeabilities (K') of strata within Unit IA are interpreted to be less than the radial permeabilities of these strata. This interpretation is based on one grain-size analysis, visual examination of split-spoon samples, and vertical permeability values obtained from texturally similar fine-grained alluvial sediments.. The vertical permeabilities of the clays and clayey silts within Unit IA are estimated to be less than about 6×10^{-4} ft/day.

If the fine-grained silty clays and clayey silts of Unit IA were laterally continuous beneath the landfill area, this unit could be regarded as an effective confining unit. However, as illustrated on figure 4, these beds thicken and thin appreciably and change lithology between wells.

4.2.2 Lower Alluvium (Unit IB)

The Lower Alluvium contains the most permeable strata penetrated in the 4 wells Information from the 3 down-gradient monitor wells indicates that ground water within Unit IB occurs under both artesian (confined) and water-table (unconfined) conditions (see fig. 4). Sediments in Unit IB are coarser and more permeable than the overlying clays and silts of Unit IA.

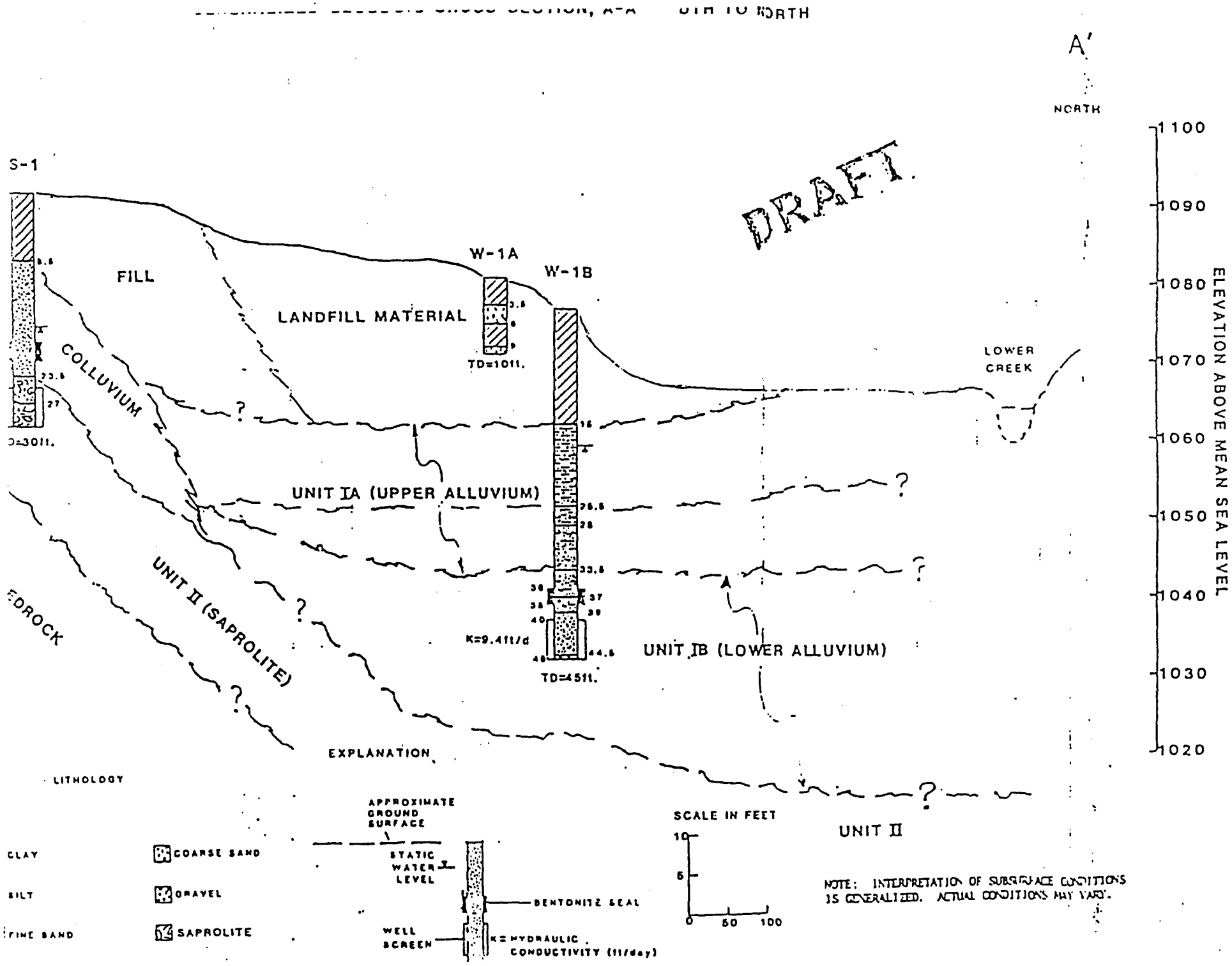
The average thickness of Unit IB strata beneath the landfill area is at least 15 ft and it may be more than 20 ft. Therefore, this unit is considered a fair aquifer.

The permeabilities of Unit IB strata are estimated to range from about 5 ft/day to more than 30 ft/day. The average permeability (K_{av}) is estimated to be about 20 ft/day. These permeability estimates are based on one grain-size analysis from Well E-1, borehole permeability tests at Wells W-1B and E-1, and visual inspection of split-spoon samples.

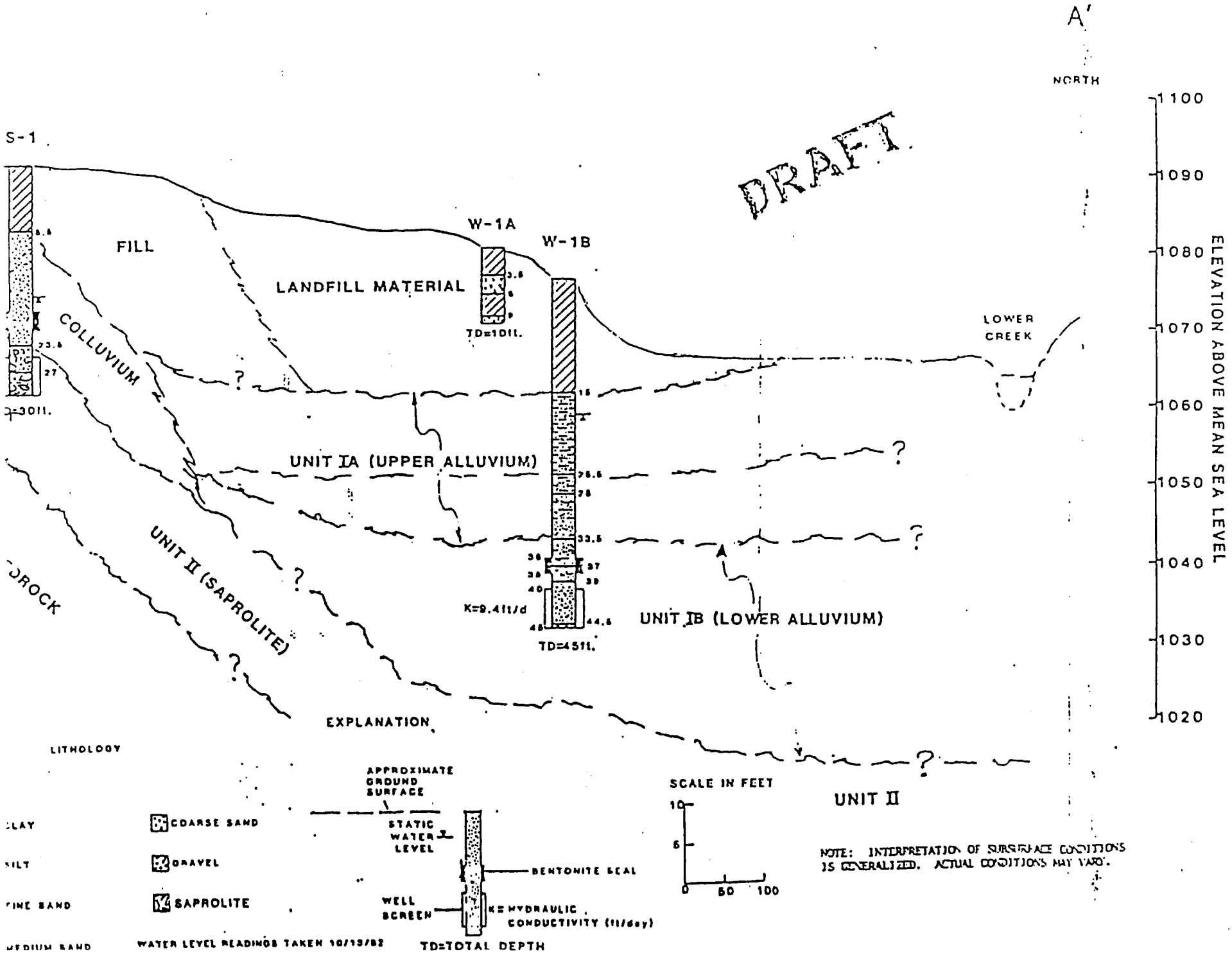
4.2.3 Saprolite (Unit II)

The saprolite was penetrated in only the background well (S-1). Therefore, there is not sufficient information on this unit to make reasonably accurate evaluations of the water-bearing properties of this unit. However, the general hydrologic properties of saprolite in other areas allows the following generalizations to be made.

Saprolite is commonly porous, with bulk porosities ranging from 30 percent to 55 percent, as indicated from porosity data obtained from thin-wall samples in other S&ME ivestigations. However, saprolitic soils commonly have low permeabilities because of the generally high content of silt and clay. Borehole permeability tests from other ground-water investigations in geologically similar areas indicate that saprolite permeabilities vary from less than 0.001 ft/day to about 5 ft/day. High saprolite permeabilities are generally the result of relict fractures and joints, and other planes of weakness. The saprolite probably functions as a confining unit


A'
NORTH
S-1
FILL
COLLUVIUM
LANDFILL MATERIAL
W-1A
W-1B
TD=1011.
TD=3011.
UNIT IA (UPPER ALLUVIUM)
UNIT II (SAPROLITE)
UNIT IB (LOWER ALLUVIUM)
UNIT II
K=9.41ft/d
TD=45ft.
LOWER CREEK
DRAFT
ELEVATION ABOVE MEAN SEA LEVEL
1100
1090
1080
1070
1060
1050
1040
1030
1020
EXPLANATION
LITHOLOGY
CLAY
SILT
FINE SAND
COARSE SAND
GRAVEL
SAPROLITE
APPROXIMATE GROUND SURFACE
STATIC WATER LEVEL
BENTONITE SEAL
WELL SCREEN
K = HYDRAULIC CONDUCTIVITY (ft/day)
SCALE IN FEET
0
50
100
NOTE: INTERPRETATION OF SUBSURFACE CONDITIONS IS GENERALIZED. ACTUAL CONDITIONS MAY VARY.

GENERALIZED GEOLOGIC CROSS-SECTION, A-A H TO NORTH



5.1 GROUND-WATER FLOW IN THE LOWER ALLUVIUM (Unit IB)

Ground-water movement through the Lower Alluvium (Unit IB) is primarily controlled by the location of natural recharge and discharge areas, and by the attitude of the underlying saprolite. The Lower Alluvium is recharged by the slow infiltration of precipitation through the overlying sediments of the Upper Alluvium (Unit IA). Lower Creek valley is the local discharge area for ground water moving through the Lower Alluvium. This conclusion is supported by the observation of the difference in water-table elevations (shown on table 4) between up-gradient Well S-1 (1075 ft) and down-gradient Well N-1 (1060 ft). As illustrated on figure 4, the flow of ground water is generally to the northwest toward the Lower Creek.

Estimates of the average linear velocity of ground water were made by using a modified form of the Darcy Equation:

$$v = \frac{K}{n_e} \cdot \frac{dh}{dL} \qquad \text{where,}$$

$\bar{v}$ = average linear velocity (ft/day); K = hydraulic conductivity (ft/day); n_e = effective porosity (percent); and dh/dL = hydraulic gradient (ft/ft).

An effective porosity (n_e) of 20 to 30 percent was estimated from specific yield (Sy) estimates by the method described by Johnson (1967). The hydraulic gradient between Wells E-1 and N-1 is estimated to be 0.02 ft/ft. Therefore, the average linear velocity of ground water moving through the Lower Alluvium is estimated to range from about 1 to 2 ft/day (350 to 700 ft/yr).

Vertical Flow:-- Deep ground-water flow paths will probably not develop beneath the landfill because of the following: 1) The short distance between the discharge and recharge areas generally precludes the development of deep paths of ground-water flow; and 2) It is reasonable to assume that the underlying sapro-

lite is less permeable than Lower Alluvium sands. Therefore, the flow of ground water through Unit IB will be deflected laterally along the top of the saprolite toward the discharge area, the valley of Lower Creek.

5.2 WATER-LEVEL FLUCTUATIONS

Ground-water levels in the North Carolina Piedmont fluctuate both in a seasonal cycle and in response to short-term rainfall events. Normally, ground-water levels are lowest in the late fall to mid-winter and higher during late winter-early spring. Water levels in wells located in recharge areas generally have a greater fluctuation than wells located in discharge areas. The water level measured in Well S-1, although screened in saprolite, is indicative of water-table level located in the recharge area of the site. Therefore, ground-water levels in this well will probably have a greater fluctuation than water levels in Wells N-1 and E-1 located in the flood plain of Lower Creek (discharge area). While no seasonal cycle of ground-water levels have been obtained, water-level fluctuations of 5 to 7 ft would be expected in Well S-1. Water-level fluctuations in Wells W-1B, E-1, and N-1 will probably be less than 5 ft. A greater fluctuatic in water levels in up-gradient (recharge area) wells compared to down-gradient wells (discharge area) wells would increase the hydraulic gradient, and therefore the potential linear velocity of the ground water. Therefore, although water-level fluctuations will probably affect the movement and dispersion of contaminants, this affect will probably not be enough to alter the probable flow of potential contaminants toward the discharge area, Lower Creek.

5.5 POTENTIAL CONTAMINANT MOVEMENT

The water table occurs in the Upper Alluvium below the landfill material. Precipitation infiltrating the full thickness of the landfill will generate leachate before intercepting the water table. Therefore, it is reasonable to expect that the ground water of the Upper Aquifer may be affected by leachate. However, upper sediments of Unit IA consist of silty clays of low permeability; therefore, the infiltration of potential contaminants is at least retarded by these clays and silts. These clays afford some protection from contamination of ground water within the underlying sands of the Lower Alluvium (Unit IB). However, where the beds of clay and silt are thin and permeable or where sand beds occur in Unit IA (such as at Well N-1), there is a greater potential for contamination of ground water in the Lower Alluvium.

Potential contamination of ground water in deeper geologic strata (bedrock) is less likely because (1) the underlying saprolite will probably act as a confining bed that retards the downward vertical movement of contaminants, and deflects ground water laterally toward the discharge area, and (2) the higher radial ("horizontal") permeability of the Lower Alluvium (Unit IB) will cause the flow of ground water within Unit IB to be primarily lateral toward Lower Creek valley; and (3) deep ground-water flow paths will probably not develop beneath the landfill because of the short distance between the recharge and discharge areas.

There are no known wells located down-gradient of the landfill. Therefore, the direction of ground-water flow toward the creek is unaffected by pumpage, and it is reasonable to expect that no water supply wells are currently being impacted by leachate contaminants.

SECTION 6.0 SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The generation of leachate by the infiltration of precipitation through the landfill is likely. The underlying clays and silts within the Upper Alluvium (Unit IA) will likely retard and attenuate at least some of this leachate. However, where Unit IA is thin and/or contains beds of permeable sand, as at Well N-1, ground water within the underlying sands of the Lower Alluvium (Unit IB) could be contaminated by leachate.

Contamination of ground water within the bedrock that underlies the landfill area is not probable because the saprolitic soils (Unit II) will probably retard the downward movement of contaminants.

Contamination of the Upper Alluvium is likely, and there is a potential for contamination of the Lower Alluvium. However, there are currently no known water-supply wells located in what is interpreted to be the down-gradient direction of ground-water and contaminant movement. Therefore, no known wells are currently being impacted by landfill leachate.

The existing wells are located in the general down-gradient direction of ground-water flow from the landfill, and therefore may be used to monitor potential movement of contaminants in the Lower Alluvium adjacent to the landfill. However, the precise direction of ground-water flow is unknown. Therefore, additional monitor wells would be needed to confirm the direction of ground-water movement and the lateral extent of contamination.

The rates of lateral ground-water movement beneath the landfill and adjacent area presented in this report are estimates which are believed to be reasonable approximations. However, should it be necessary to more accurately determine ground-water flow rates and the rates of contaminant dispersion, additional field and laboratory testing would be necessary.

A systematic ground-water monitoring program is recommended to (1) establish

the range of water-level fluctuations in the hydrogeologic units beneath and adjacent to the landfill, (2) establish baseline, or background, ground-water quality data, (3) monitor the movement of contaminants, and (4) evaluate the effects of contaminant movement.

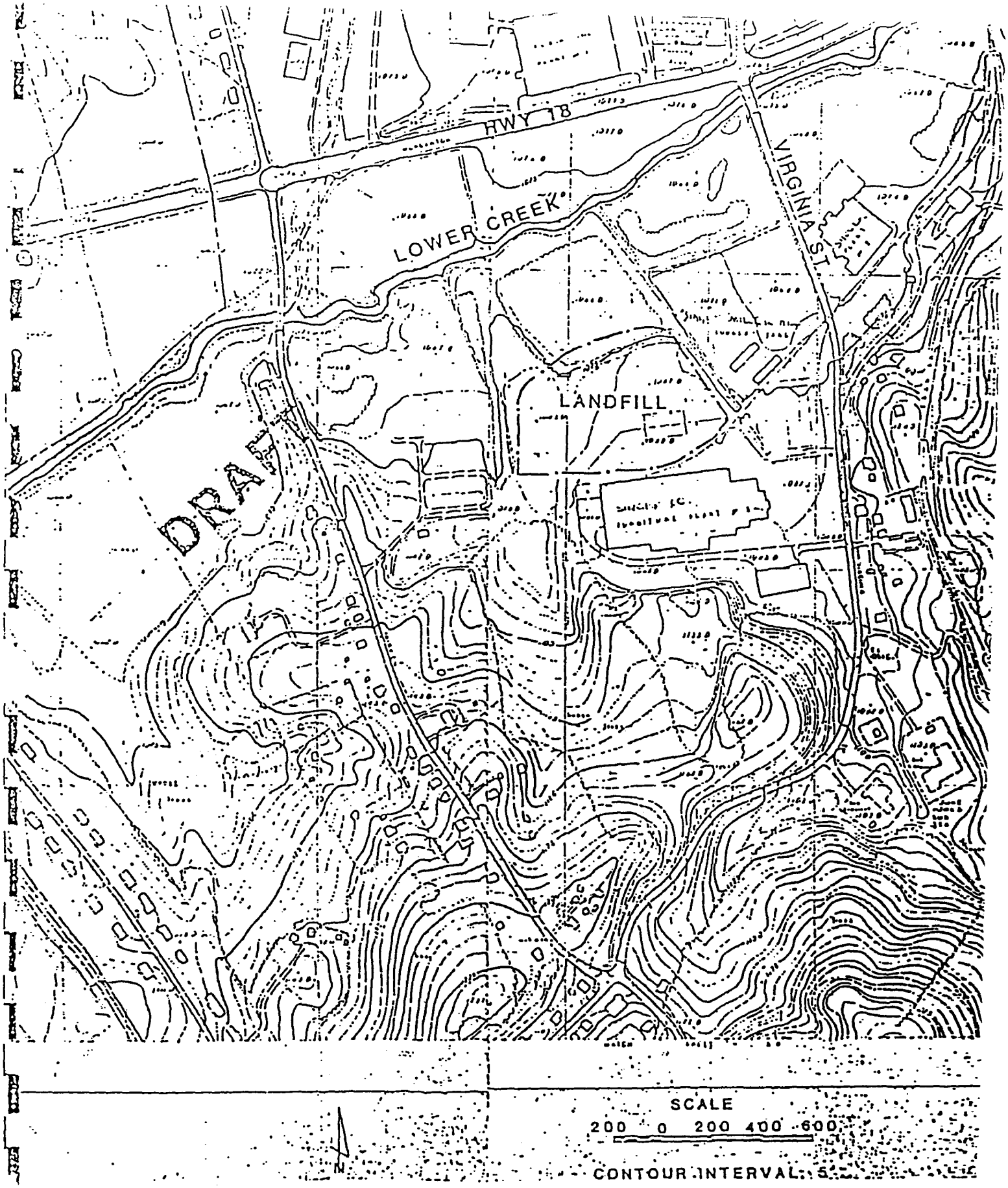
General information on water wells in the general area of the Plant site were obtained from the N. C. Department of Natural Resources and Community Development and conversations with Singer personnel. It would be prudent to perform a systematic well survey of homes and industrial establishments located east-southeast of the plant site to verify whether the Alluvium is used as a source of drinking water supply.

In order to reduce the generation of leachate, the surface of the landfill should be maintained in order to eliminate as much as possible the infiltration of rainfall and surface drainage. Existing pits on the surface of the landfill should be filled with impermeable soil.

SECTION 7.0 SELECTED REFERENCES

Goldsmith, R., Milton, D. F., and Wilson, F. A., 1978, Preliminary Geologic Map, Geologic Map Index, and Annotated Bibligraphy, Charlotte 2° Sheet, North Carolina and South Carolina: Open-File Rept. No. 78-590, U. S. Geol. Survey, Reston, Virginia.

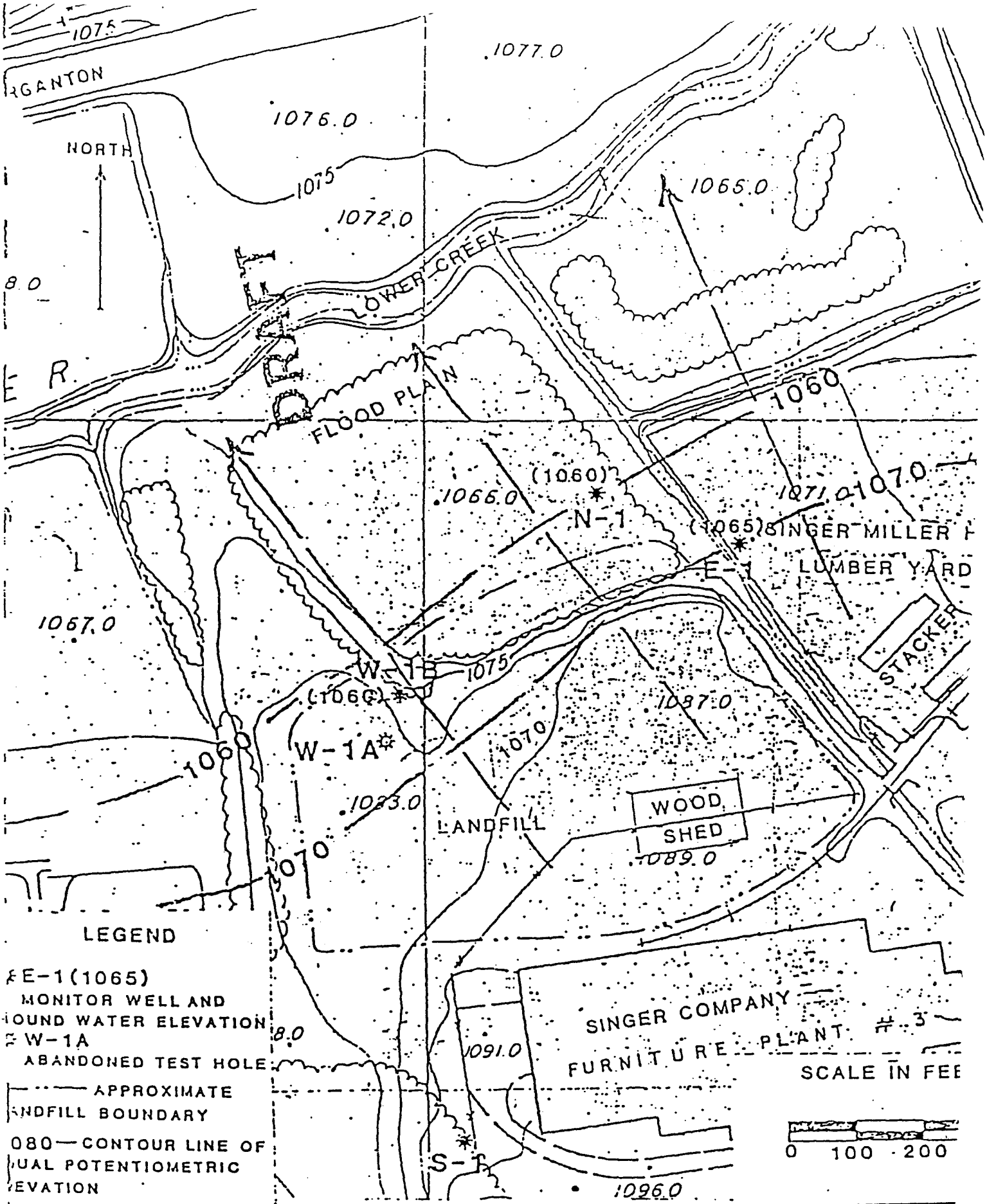
Johnson, A. I., 1967, Specific Yield of Granular Sediments: U. S. Geol. Survey Water-Supply Paper 1662-D.



igure 1. Topographic ap of the landfill site and vicinity.

SOIL & MATERIAL ENGINEERS INC.
ENGINEERING-TESTING-INSPECTION
COLUMBIA, SOUTH CAROLINA

Base map from to graphic map suppl Singer Co., Lenoi



gure 5. Generalized
p of ground water flow
hin Unit TB.

SOIL & MATERIAL ENGINEERS INC.
ENGINEERING-TESTING-INSPECTION
COLUMBIA, SOUTH CAROLINA

Base map from top
graphic map supplie
Singer Co., Lenoir,

WELL CONSTRUCTION SCHEMATIC

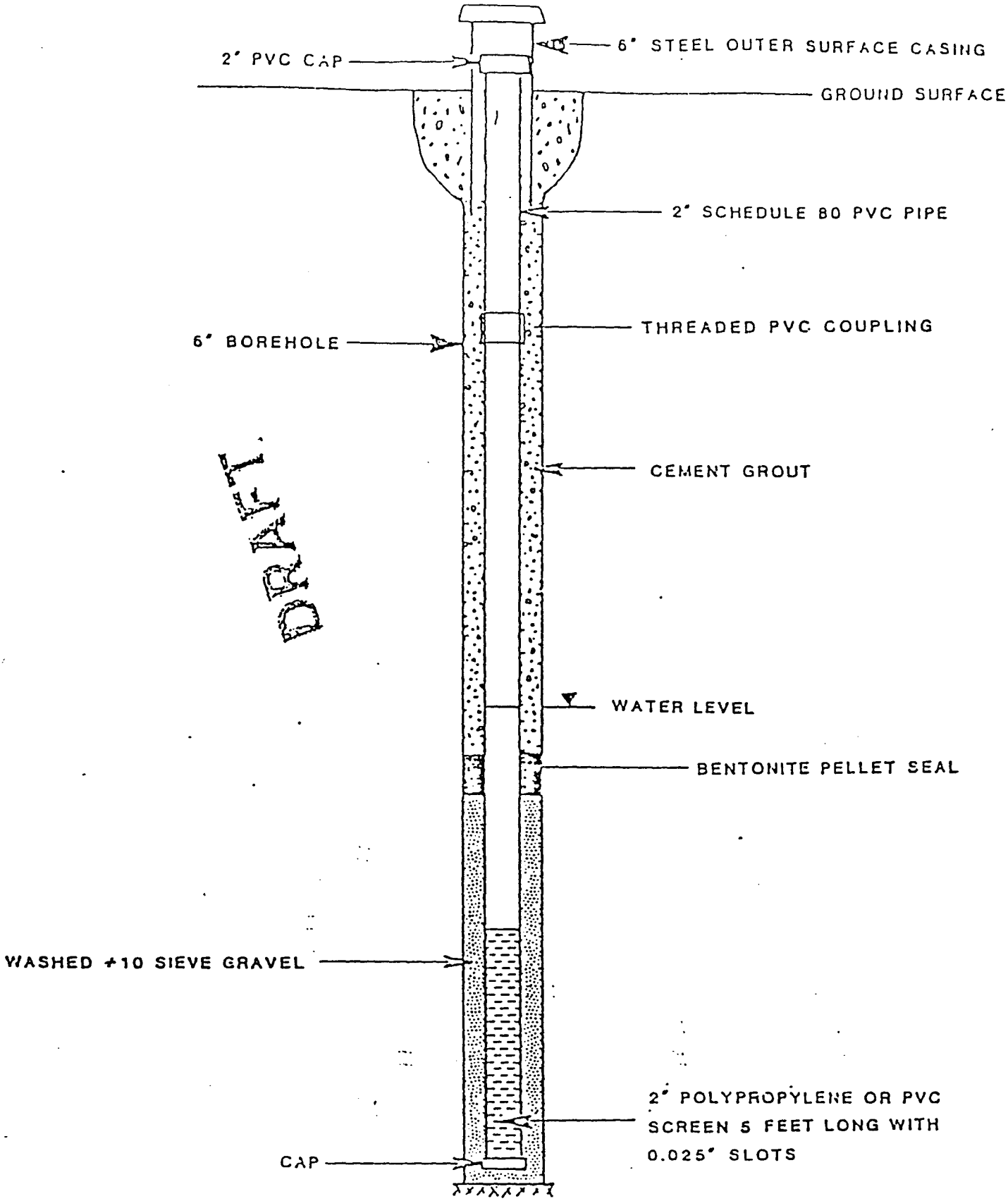


FIGURE 6. Well Construction Schematic of Typical Monitor Well.

TABLE 1. TEST BORING AND WELL CONSTRUCTION DATA

DRAFT

Well Field No.	SEME Well Report No.	Land-Surface Elevation (FT MSL)[1]	Casing Stick Up	Elevation Top of Casing (TOC)	Original Boring Depth	Screen Depth	Gravel Depth	Depth Well Seal	Remarks
TH-1A	W-1A	1081	None	None	10	None	None	None	Abandoned because garbage and debri
TH-1B	W-1B	1077	2.9	1079.9	45	40-45	38-45	36-38	
TH-2	N-1	1067	3.3	1070.3	21.5	9.7-19.7	8.5-21.5	6.5-8.5	
TH-3	E-1	1071	3.9	1074.8	35	27-32	25-32	23-25	
TH-4	S-1	1092	2.9	1094.8	30	25-30	21.5-30	19-21.5	Background Observation Well

NOTE: [1]Estimated from topographic map of site supplied by the Singer Company

SEME Job No. 4482-1

TABLE 2. SUMMARY OF WELL CONSTRUCTION DATA

DRAFT

STATE North Carolina

SOIL & MATERIAL ENGINEERS WELL SUMMARY

COUNTY Caldwell

SMV. JOB NO. #487-129

Well No.	State Number	SME Well No.	Elevation (MSL)	Owner/Location	Well Use	Total Depth	Casing Dia.	Casing Depth	Pump Rate	Date Comp.	Logs	Chemical Analyses	Well Cons.	Remarks
TH-1A		W-1A	1081 ft.	Singer-Lenoir West of Landfill		10 ft.	None			10/12/82	Drillers			Test hole abandoned because of garbage and debris.
TH-1B		W-1B	1077 ft.	Singer-Lenoir West of Landfill	OBS	45 ft.	2-in.	40 ft.		10/12/82	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 40-45 ft, set in slightly silty, medium sand to small gravel.
TH-2		N-1	1067 ft.	Singer-Lenoir North of Landfill	OBS	21.5 ft.	2-in.	9.7 ft.		10/12/82	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 9.7-19.7 ft, set in fine to coarse sand, slightly silty to silty.
TH-3		E-1	1071 ft.	Singer Lenoir East of Landfill	OBS	35 ft.	2-in.	27 ft.		10/13/82	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 27-37 ft, set in medium to coarse sand.
TH-4		S-1	1092 ft.	Singer-Lenoir South of Landfill by Main Plant Bldg.	OBS	30 ft.	2-in.	25 ft.		10/14/82	Drillers	Inorganic Pesticide Volatile	GP	Screen 25-30 ft, set in saprolite. Background observation well.

SME HD-3 (rev. 11/67)

TABLE 3. SUMMARY OF PHYSICAL LABORATORY TESTS

DRAFT

Well No.	Depth of Sample (ft)	Sample Description	Hydrogeologic Unit	% Silt and Clay (0.074 mm)	Estimated[1] Effective Porosity n_e
W-1B	28.5 - 30	Slightly Sandy CLAY	Unit 1A	79.1	5 - 10%
E-1	18.5 - 20	Silty SAND	Unit 1B	22.0	20%

NOTE: [1]Based on information from Johnson, 1967

SCME Job No. 4482-129

Table 4. Summary of Water Level Data

DRAFT

WELL NO.	ELEV. M.P.	DATE MEASURED	WATER LEVEL BELOW M.P.	WATER LEVEL ELEV.	MEASURED BY	REMARKS
W-1B	1079.9	10/13/82	20.5	1058.4	Curt Gorman	Well screened in Unit IB
N-1	1070.3	10/13/82	10.4	1059.9	Curt Gorman	Well screened in Unit IA/IB
E-1	1074.8	10/13/82	9.9	1064.9	Curt Gorman	Well screened in Unit IB
S-1	1094.8	10/14/82	20.2	1074.6	Chris Silkwood	Well screened in Unit II

NOTE: Measuring Point (MP) of all wells is top of cas (TOC)

S&ME Job No. 4482-129

TABLE 5. SUMMARY OF FIELD BOREHOLE PERMEABILITY TESTS

DRAFT

ELL NO.	DEPTH OF SCREEN INTERVAL TESTED (ft)	ESTIMATED RADIAL HYDRAULIC CONDUCTIVITY (cm/sec)	(ft/day)	HYDROGEOLOGIC UNIT	LITHOLOGY	REMARKS
-IB	40-45	3.3×10^{-4}	9.4	Unit IB	Slightly Silty Sand	
-I	27-32	8.6×10^{-3}	24.4	Unit IB	Slightly Silty, medium to coarse Sand	
-I	9.7-19.7	7.0×10^{-5}	0.2	Unit IA/Unit IB	Silt, and fine to coarse Sand	Well screen not fully developed, therefore calculated permeability is considered lower than actual permeability

NOTE: Falling head tests performed October 13, 1982

S&ME JOB NO. 4482-129

SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-18

Logged by: C. Corman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 45 ft. Static Water Level: 20.5 ft

Date Completed: 10/12/82 Well Depth: 45 ft. Permeability Tests: Falling Head

Drilling Method: Auger Casing: 2-in. PVC Sch 80 Thrd. 0-40 ft.

Development Method: Flushed 100 gal. water Screen: 2-in PVC Sch 80 Thrd. .025-in. slot 40-45 ft. Seal: Bentonite 36-38 ft.

Soil Samples: Split Spoon Grout: Portland, 0-36 ft.

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

Elev. ±1077	Depth Ft.	Description	Blows per ft. (3 10 20 30 40 60)
		Fill, silt, wood debris, charcoal, glass.	
SS			
		Fill, as above.	
		Water table at approximately 13 ft in borehole.	
	15.0		
SS		Clay, grey, firm, sticky, silty, some muscovite flakes, with large amounts of imbedded medium-to-coarse grained, subangular sand.	
		Clay, medium brown, grey, mottled, soft-to-firm, sticky, slightly silty, with some muscovite flakes, sand content very low, medium- to-coarse grained, very faint oil odor.	
SS			
		Clay, as above, plastic, no odor; grading to	
SS			
	25.5	Silt, blue/grey, very clayey, plastic and sticky, with very small amounts of fine grained sand. Very loose, muscovitic, sand content increasing at 28 ft.	
	28.0		
SS			
	33.0	Sand blue/grey, very fine, some coarse grained, subrounded to subangular, moderately sorted, very silty, slightly clayey, muscovite.	
SS			

DRAFT

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W

Logged by: C. Corman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: ___

Date Started: 10/12/82 Boring Depth: 45 ft. Static Water Level: 20.5

Date Completed: 10/12/82 Well Depth: 45 ft. Permeability Tests: Falling Hea

Drilling Method: Auger Casing: 2-in. PVC Sch 80 Thrd. 0-40 ft.

Development Method: Flushed 100 gal. water Screen: 2-in PVC Sch 80 Thrd, .025- in. slot, 40-45 ft. Seal: Bentoni 36-38 ft

Soil Samples: Split Spoon Grout: Portland, 0-36 ft.

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

	Elev.	Depth Ft.	Description	5 10 20 30 40 60
		37.0	Silt, grey, with some fine grained sand.	
	SS	39.0	Sand, light yellow/brown, to red/brown from staining, very fine to coarse, predominantly medium grained, subangular, poorly sorted, very slightly silty, muscovite and biotite flakes-fine, some orange oxide stains; grading to medium-to-coarse grained sand at 43.5 ft; large gravelly layer, subangular to rounded at 44.5 ft, imbedded with medium-to-coarse grained sand, muscovite and biotite flakes present.	
	SS	43.5		
		44.5		
		45.0		

Boring terminated at 45 ft.

DRAFT

SS = Split-Spoon Sample

SOIL BORING AND WELL RECORD

Location: The Singer Co. Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: E-1(

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/13/82 Boring Depth: 35 ft. Static Water Level: 9.9 ft

Date Completed: 10/13/82 Well Depth: 32 ft. Permeability Tests: Falling Head

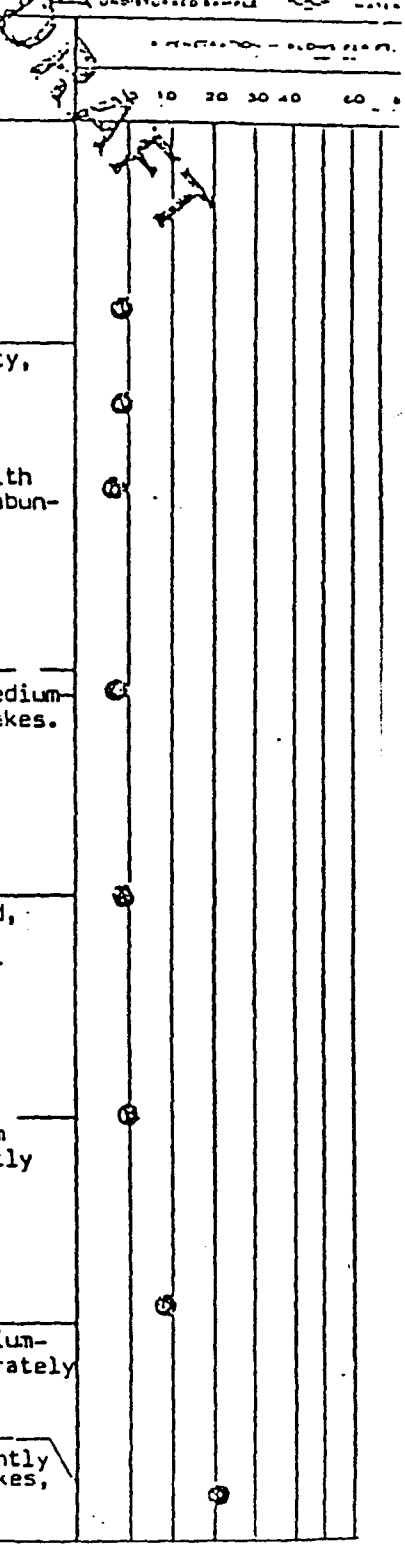
Drilling Method: Auger Casing: 2-in PVC Sch 80 Thrd, 0-27 ft.

Development Method: Air Compressor Screen: 2-in PVC Sch 80 Thrd, .025-in slot, 27-32 ft. Seal: Bentonite, 23-25 ft

Soil Samples: Split Spoon Grout: Portland, 0-23 ft.

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

	Elev. ±1071	Depth Ft.	Description
			Fill, silt, rock fragments, muscovite flakes, debris.
	SS		
		5.5	Clay, dark grey, soft-firm, sticky-plastic, slightly silty, with some fine grained imbedded sand, muscovite flakes present.
	SS		
	SS		Clay, blue/grey, soft, sticky-plastic, slightly silty, with some imbedded medium-to-coarse grained sand, quartzose, abundant muscovite flakes.
		13.5	
	SS		Silt, blue/grey, soft, very clayey, with some imbedded medium-to-coarse grained sand, quartzose, abundant muscovite flakes.
	SS	19.0	Sand, grey, very fine-t-fine grained, some medium grained, subangular, very silty, clayey, poorly sorted, abundant muscovite flakes; interbedded with small silt layers containing very fine sand.
	SS	24.5	Sand, grey, loose, very fine-to-fine grained, some medium grained, subrounded to subangular, slightly silty, slightly clayey, moderately sorted, muscovite flakes present.
	SS	29.5	Sand, light yellow, with some orange/brown staining, medium-to-coarse grained, subangular, very slightly silty, moderately sorted, muscovite-biotite in fine particals, some oxide staining.
	SS	33.5	Sand, fine grained to large gravel, yellow/brown, slightly silty, very poorly sorted, abundant gold muscovite flakes, biotite, quartz and feldspar fragments.
		35.0	Boring terminated at 35 ft.



SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-1A

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 10 ft. Static Water Level: None

Date Completed: 10/12/82 Well Depth: Abandoned Permeability Tests: None

Drilling Method: Auger Casing: None

Development Method: None Screen: None Seal: None

Soil Samples: Split Spoon Grout: None

Geophysical Logs: None Chem. Analysis: None

	Elev. ±1081	Depth Ft.	Description
			Silt, red/brown, finely to medium sandy, quartzose, some muscovite flakes.
	SS	3.5	Garbage, wood debris, cans.
	SS	6.0	Sand, red/brown, very fine-to-coarse grained, subangular, very silty, gneissic composition.
	SS	9.0	Debris hindering drilling - 9.3 ft.
		10.0	Abandoned test hole at 10 ft. due to garbage and debris.

SS = Split-Spoon Sample

SOIL BORING AND WELL RECORD

Location: The Singer Co.-Lenoir County: Caldwell, N.C. Job No.: 4482-129 Boring or Well No.: N-1

Logged by: C. Corman Drilled by: C. Silkwood Grid Coord.: 21.5 ft. Lat.-Long.: ___

Date Started: 10/11/82 Boring Depth: 21.5 ft Static Water Level: 10.4 ft

Date Completed: 10/12/82 Well Depth: 19.7 ft. Permeability Tests: Falling Head

Drilling Method: Auger Casing: 2-in PVC, Sch 80 Thrd, 0-9.7 ft.

Development Method: Flushed 100 gal. water Screen: 2-inch PVC Sch 80 Thrd, .025-in slot 9.7 - 19.7 SEAL: Bentonite 6.5

Soil Samples: Split Spoon Grout: Portland 0-6.5 ft.

Geophysical Logs: none Chem. Analysis: Inorganic & Organic

Elev. ±1067	Depth Ft.	Description
		Silt, red/brown, with very fine grain, some coarse grained, quartzose, subangular sand, strong propellant odor.
		Silt, light red/brown, with very fine grain, some coarse grained, quartzose, subangular sand, clayey, micaceous, feldspar grains, strong propellant odor, rags and debris from 4.5 to 5.0 ft.
	3.5	
SS	4.5	Clay, grey/black, firm, sticky, with some imbedded very fine-to-fine, some coarse grained sand, very fine muscovite flakes, some organic material and rag fibers.
	5.0	
SS		
	8.0	Sand, grey/black, loose, very fine-to-medium grained, slightly silty, predominately quartzose, some feldspathic grains, subrounded to subangular, moderately sorted, abundant muscovite, no odor, wet.
SS		
	12.0	Silt, grey, with fine-grained sand, grading to silty sand.
SS	14.0	Sand, grey, fine-to-very coarse grained, firm, predominantly quartzose, some feldspathic grains, subrounded to subangular, poorly sorted, some muscovite flakes, larger grains are angular.
SS		
	20.0	Grading to brownish-grey silty sand at 20 ft.
	21.5	Boring terminated at 21.5 ft.

SS = Split-Spoon Sample

SOIL BORING AND WELL RECORD

Location: The Singer Co-Lenoir County: Caldwell, N.C. Job No.: 4482-129 Boring or Well No.: S-1(

Logged by: C. Silkwood Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/13/82 Boring Depth: 30 ft Static Water Level: 20.2 ft

Date Completed: 10/14/82 Well Depth: 30 ft Permeability Tests: none

Drilling Method: Auger Casing: 2-in PVC, Sch 80 Thrd, 0-25 ft

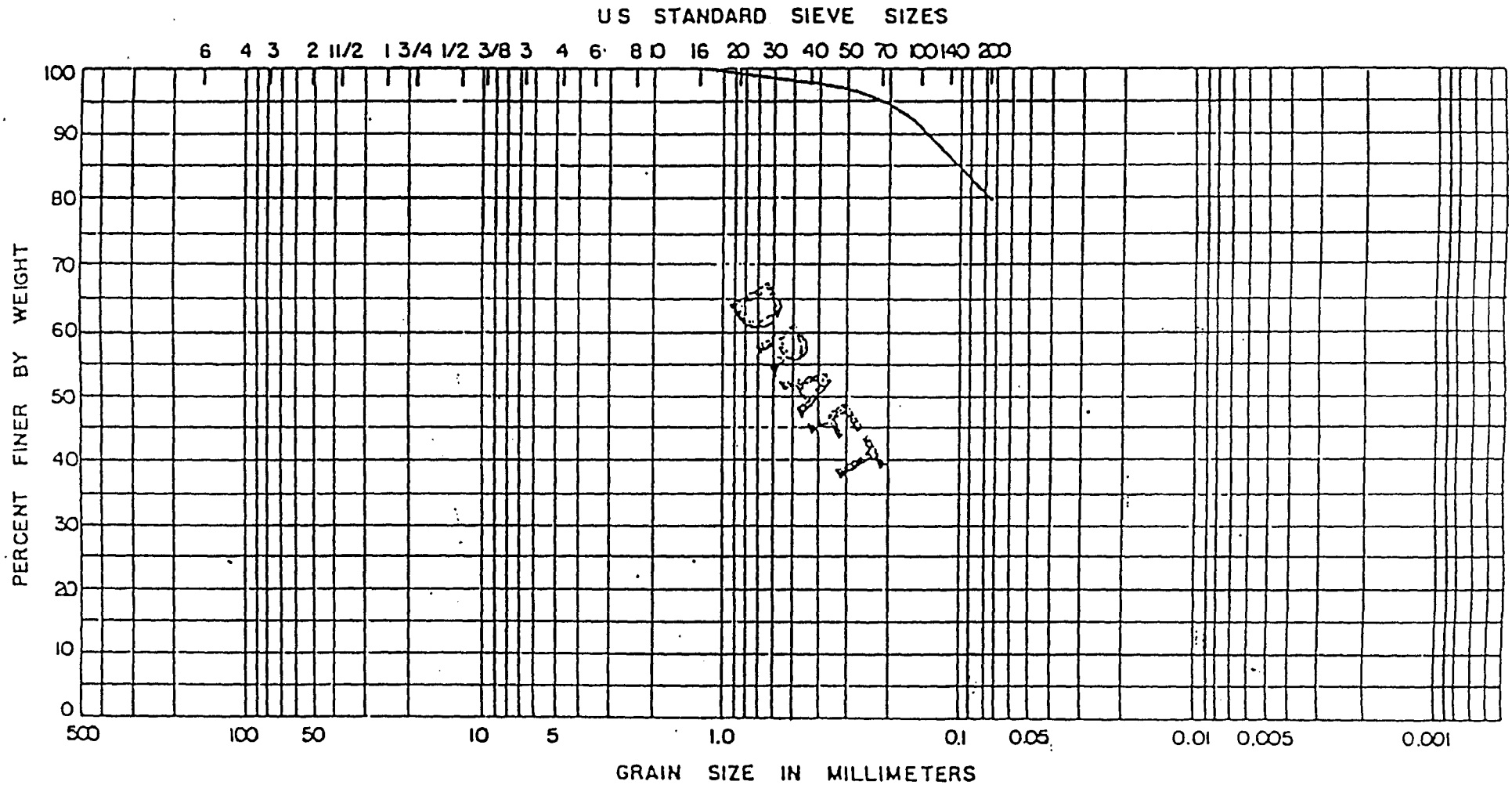
Development Method: Flushed 140 gal. water Screen: 2-in PVC, Sch 80, Thrd, .025-in slot, 25-30 ft Seal: Bentonite 19-

Soil Samples: Split Spoon Grout: Portland 0-19 ft.

Geophysical Logs: none Chem. Analysis: Inorganic & Organic

	Elev. ±1092	Depth Ft.	Description
			Silt, red/brown, loose-to-firm, slightly clayey, with fine to medium grained, quartzose sand, some muscovite flakes and weathered feldspar fragments, some organic material. Fill.
	SS		Silt, as above
	SS	8.5	Sand, orange/white, firm, with very fine to coarse grained quartz and feldspar fragments, silty, some biotite and muscovite, highly weathered.
	SS		Sand, as above, yellow/brown, large feldspar fragments, silty.
	SS		Sand, red/brown, firm, with very fine to coarse grained quartz and feldspar grains, large feldspar fragments not as numerous, heavily muscovitic, moist, highly weathered.
	SS	23.5	Saprolite, red/brown, white, mottled, quartzose and feldspathic grains and fragments, feldspars are soft, heavily weathered, dark minerals-augite, in fragments, very silty, very fine rock fragments.
	SS	27.0	Saprolite, white to brown, quartzose and feldspathic grains and fragments, feldspars firmer, abundant muscovite, sand grains predominantly coarse, biotite flakes - very fine, heavily weathered.
		30.0	Boring terminated at 30 ft.

SS = Split-Spoon Sample



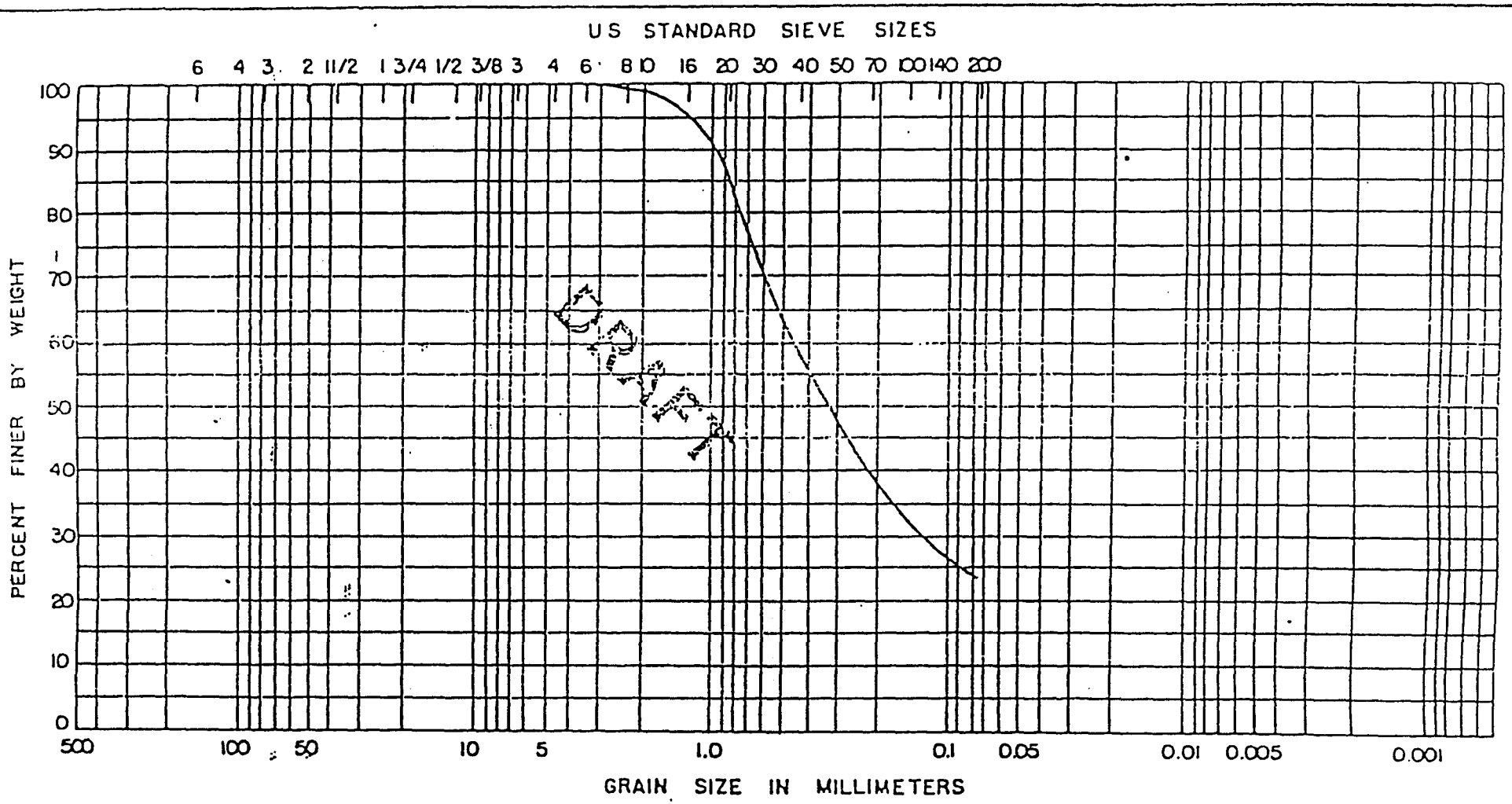
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
W-1B	28.5'-30.0'					UNIT 1A Grayish, Slightly Sandy CLAY

GRAIN SIZE DISTRIBUTION

JOB NO. 4482-129

SOIL & MATERIAL ENGINEERS, INC.



BOULDERS	COBBLES	GRAVEL		SAND			FINES		
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES		CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
E-1	18.5'-20.0'					UNIT 1B Grayish, Silty SAND

GRAIN SIZE DISTRIBUTION

JOB NO. 4482-129

SOIL & MATERIAL ENGINEERS, INC.

ENWRIGHT LABORATORIES, INC.
A subsidiary of ENWRIGHT ASSOCIATES, INC.

CLIENT: J.E. Sirrine

PROJECT: Singer - Lenoir

DATE RECEIVED: 10/20/82

AMENDED REPORT

ANALYSES COMPLETED: 11/30/82

DATE REPORTED: 12/7/82

Lab # / Sample ID	11660 Test Hole #1 (W-1B)	11661 Test Hole #2 (N-1)	11662 Test Hole #3 (E-1)	11663 Test Hole #4 (S-1)
Antimony	<1.0	<1.0	<1.0	<1.0
Arsenic	<1.0	93	<1.0	<1.0
Beryllium	1.7	56	<0.5	2.6
Cadmium	0.6	6.8	<0.1	0.9
Chromium	20	400	<1.0	2.3
Copper	30	650	<1.0	100
Lead	14	600	<1.0	10
Mercury	<0.2	<0.2	<0.2	<0.2
Nickel	<40	230	<40	<40
Selenium	<3.0	<3.0	<3.0	<3.0
Silver	<0.1	<0.1	<0.1	<0.1
Thallium	<1.0	<1.0	<1.0	<1.0
Zinc	70	1100	<10	130
Barium	900	6100	200	1100
Phenol, mg/l	<0.002	<0.002	<0.002	<0.002
Cyanide, mg/l	<0.02	<0.02	<0.02	<0.02
pH, units	7.1	6.5	6.7	6.9
Specific Conductance, µmhos	140	360	170	130
Dissolved Organic Carbon, mg/l	10	31	18	1
Chloride, mg/l	2	17	4	4
Nitrate, mg/l	2.0	0.9	1.0	0.4
Sulfate, mg/l	13	30	13	13

All results are reported in µg/l unless otherwise specifed.

Analytical methods used are those approved by the U.S. Environmental Protection Agency for NPDES monitoring, unless otherwise specified.

Respectfully submitted,

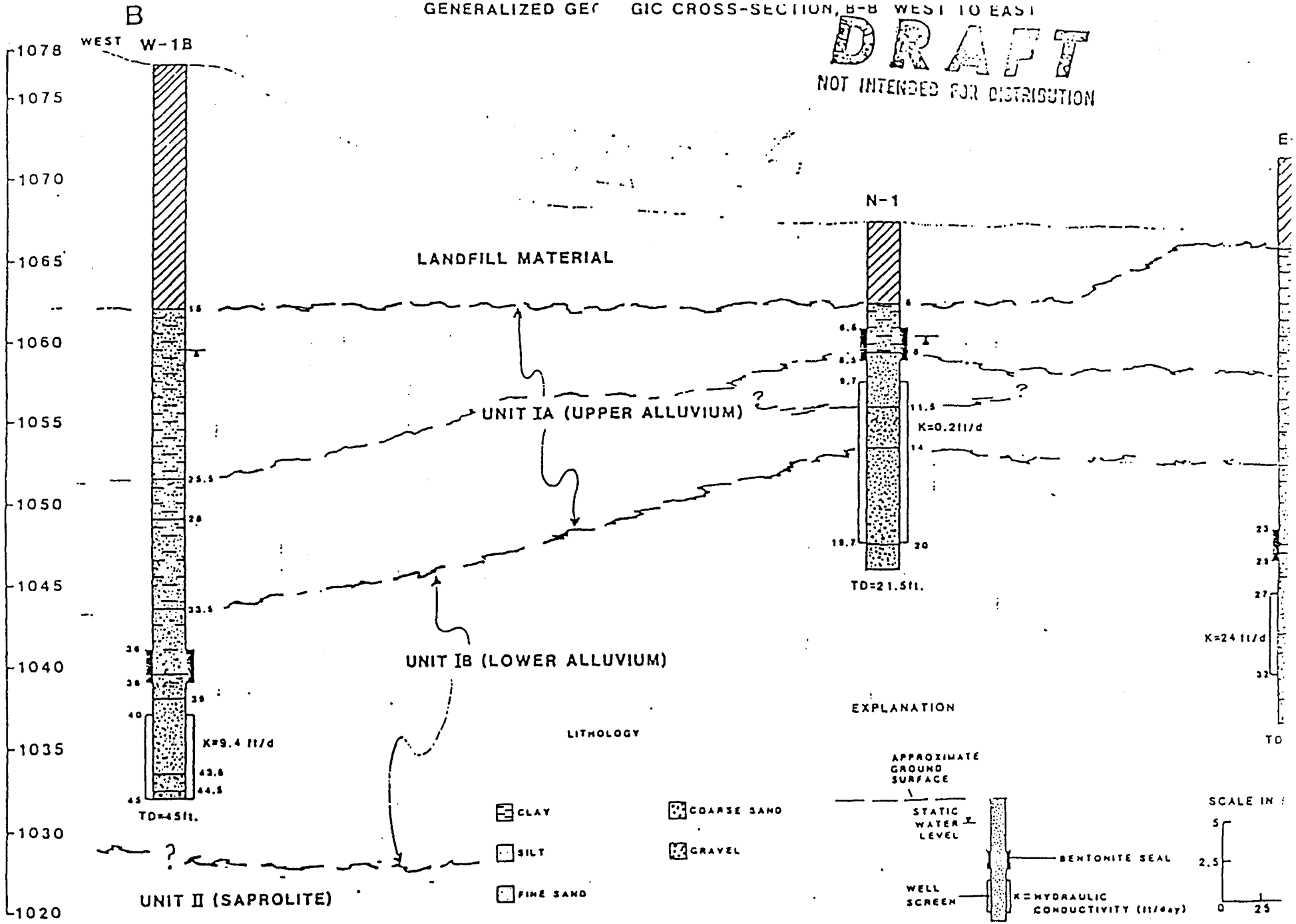
Sam W. Avery, Jr.
Analytical Department Head

SWA/pw

104 Tower Drive Greenville, South Carolina 29607 (803) 235-0707

GENERALIZED GEOLOGIC CROSS-SECTION, B-B' WEST TO EAST

DRAFT
NOT INTENDED FOR DISTRIBUTION



NOTE: INTERPRETATION OF SUBSURFACE CONDITIONS IS GENERALIZED. ACTUAL CONDITIONS MAY VARY.

CEIVED: 10/21/82

RESULTS BY SAMPLE

MPLE ID TH-2 FRACTION 02A. TEST CODE BPEST NAME Pesticide Compounds

DATA FILE 4U10039BP02 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
NC. FACTOR _____ DATE INJECTED 11/08/82 COMPOUNDS DETECTED 0

DES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1P	89P	aldrin	ND	2P	102P	alpha BHC	ND
10P	90P	dieldrin	ND	3P	103P	beta BHC	ND
6P	91P	chlordane	ND	4P	104P	Lindane - gamma BHC	ND
7P	92P	4,4'-DDT	ND	5P	105P	delta BHC	ND
8P	93P	4,4'-DDE	ND	18P	106P	PCB-1242	ND
9P	94P	4,4'-DDD	ND	19P	107P	PCB-1254	ND
11P	95P	alpha endosulfan	ND	20P	108P	PCB-1221	ND
12P	96P	beta endosulfan	ND	21P	109P	PCB-1232	NI
14P	97P	endosulfan sulfate	ND	22P	110P	PCB-1248	NI
14P	98P	endrin	ND	23P	111P	PCB-1260	NI
15P	99P	endrin aldehyde	ND	24P	112P	PCB-1016	NI
16P	100P	heptachlor	ND	25P	113P	toxaphene	NI
17P	101P	heptachlor epoxide	ND			methoxychlor	N

AMPLE ID TH-2 FRACTION 02A TEST CODE BPEST NAME Pesticide Compounds

e following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN CODE	COMPOUND	RESULT
1615 IS1P	d10-phenanthrene	10

OTES AND DEFINITIONS FOR THIS REPORT.
SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
Methoxychlor is routinely searched in all Pesticide scans.
It is not a priority pollutant.
UTD = Unable to determine due to interference from unresolved components.

PLE ID TH-2 FRACTION 02B TEST CODE VOA NAME Volatile Compounds

DATA FILE 4U10039V02R DATE INJECTED 10/25/82 ANALYST VL VERIFIED BY RS

C. FACTOR _____ COMPOUNDS DETECTED 2

DES	SCAN	EPA	COMPOUND	RESULT	NPDES	SCAN	EPA	COMPOUND	RESULT
1V		2V	acrolein	ND	17V		32V	1,2-dichloropropane	ND
2V		3V	acrylonitrile	ND	18V		33V	1,3-dichloropropylene	ND
3V		4V	benzene	ND	19V	427	38V	ethylbenzene	55
6V		6V	carbon tetrachloride	ND	22V		44V	methylene chloride	ND
7V		7V	chlorobenzene	ND	21V		45V	methyl chloride	ND
15V		10V	1,2-dichloroethane	ND	20V		46V	methyl bromide	ND
27V		11V	1,1,1-trichloroethane	ND	5V		47V	bromoform	ND
14V		13V	1,1-dichloroethane	ND	12V		48V	dichlorobromomethane	ND
28V		14V	1,1,2-trichloroethane	ND	30V		49V	trichlorofluoromethane	ND
23V		15V	1,1,2,2-tetrachloroethane	ND	13V		50V	dichlorodifluoromethane	ND
9V		16V	chloroethane	ND	8V		51V	chlorodibromomethane	ND
4V		17V	bis (chloromethyl) ether	ND	24V		85V	tetrachloroethylene	ND
10V		19V	2-chloroethylvinyl ether	ND	25V	358	86V	toluene	166
11V		23V	chloroform	ND	29V		87V	trichloroethylene	ND
16V		29V	1,1-dichloroethylene	ND	31V		88V	vinyl chloride	ND
26V		30V	1,2-trans-dichloroethylene	ND					

MPLE ID TH-2 FRACTION 02B TEST CODE VOA NAME Volatile Compounds

e following are results for inter-laboratory QA/QC for EPA Method 624.

SCAN	CODE	COMPOUND	RESULT
89	IS1V	bromochloromethane	40
245	IS2V	2-bromo-1-chloropropane	40
327	IS3V	1,4-dichlorobutane	40
129	S1V	d4-1,2-dichloroethane	87 %
354	S2V	d8-toluene	92 %
421	S3V	d10-ethylbenzene	79 %

TES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 624, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

CEIVED. 10/21/82 RESULTS BY SAMPLE

MPLE ID TH-3 (E-1) FRACTION 03A TEST CODE ACID NAME Acid Compounds

DATA FILE 3U10039A03 DATE EXTRACTED 10/26/82 ANALYST RS VERIFIED BY RS
INC. FACTOR _____ DATE INJECTED 11/18/82 COMPOUNDS DETECTED 0

DES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
11A	21A	2,4,6-trichlorophenol	ND	7A	58A	4-nitrophenol	ND
8A	22A	p-chloro-m-cresol	ND	5A	59A	2,4-dinitrophenol	ND
1A	24A	2-chlorophenol	ND	4A	60A	4,6-dinitro-o-cresol	ND
2A	31A	2,4-dichlorophenol	ND	9A	64A	pentachlorophenol	ND
3A	34A	2,4-dimethylphenol	ND	10A	65A	phenol	ND
6A	57A	2-nitrophenol	ND				

ie following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1052	IS1A	d10-phenanthrene	10
572	S1A	d4-2-nitrophenol	62 %
430	S2A	d5-phenol	49 %

IOTES AND DEFINITIONS FOR THIS REPORT.
SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

MPLE ID TH-3 FRACTION 03A TEST CODE BASE NAME Base Neutral Compounds

DATA FILE 4U10039BP03 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
NC. FACTOR _____ DATE INJECTED 11/08/82 COMPOUNDS DETECTED 0

DES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1B	1B	acenaphthene	ND	41B	61B	N-nitrosodimethylamine	ND
4B	5B	benzidine	ND	43B	62B	N-nitrosodiphenylamine	ND
46B	8B	1,2,4-trichlorobenzene	ND	42B	63B	N-nitrosodi-n-propylamine	ND
33B	9B	hexachlorobenzene	ND	13B	66B	bis(2-ethylhexyl)phthalate	ND
36B	12B	hexachloroethane	ND	15B	67B	butyl benzyl phthalate	ND
11B	18B	bis(2-chloroethyl)ether	ND	26B	68B	di-n-butyl phthalate	ND
16B	20B	2-chloronaphthalene	ND	29B	69B	di-n-octyl phthalate	ND
20B	25B	1,2-dichlorobenzene	ND	24B	70B	diethyl phthalate	ND
21B	26B	1,3-dichlorobenzene	ND	25B	71B	dimethyl phthalate	ND
22B	27B	1,4-dichlorobenzene	ND	5B	72B	benzo(a)anthracene	ND
23B	28B	3,3'dichlorobenzidine	ND	6B	73B	benzo(a)pyrene	ND
27B	35B	2,4-dinitrotoluene	ND	7B	74B	3,4-benzofluoranthene	ND
28B	36B	2,6-dinitrotoluene	ND	9B	75B	benzo(k)fluoranthene	ND
29B	37B	1,2-diphenyhydrazine	ND	18B	76B	chrysene	ND
31B	39B	fluoranthene	ND	2B	77B	acenaphthylene	ND
17B	40B	4-chlorophenyl phenyl ether	ND	3B	78B	anthracene	ND
14B	41B	4-bromophenyl phenyl ether	ND	8B	79B	benzo(ghi)perylene	ND

GL JD SPECTRIX REPORT LAB # 82 10 037

CEIVED: 10/21/82

RESULTS BY SAMPLE

CONTINUED FROM ABOVE

MPLE ID TH-3 FRACTION 03A TEST CODE BASE NAME Base Neutral Compounds

12B	42B	bis(2-chloroisopropyl)ether	ND	32B	80B	fluorene	ND
10B	43B	bis(2-chloroethoxy)methane	ND	44B	81B	phenanthrene	ND
34B	52B	hexachlorobutadiene	ND	19B	82B	dibenzo(a,h)anthracene	ND
35B	53B	hexachlorocyclopentadiene	ND	37B	83B	indeno(1,2,3-cd)pyrene	ND
38B	54B	isophorone	ND	45B	84B	pyrene	ND
39B	55B	naphthalene	ND		129B	dioxin	ND
40B	56B	nitrobenzene	ND				

ie following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1620	IS1B	d10-phenanthrene	10
851	S1B	d5-2-nitrobenzene	40 %
968	S2B	d8-naphthalene	61 %
1420	S3B	d10-fluorene	65 %
2161	S4B	d12-chrysene	78 %

OTES AND DEFINITIONS FOR THIS REPORT.

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ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

CEIVED: 10/21/82 RESULTS BY SAMPLE

MPLE ID TH-3 FRACTION 03A TEST CODE BPEST NAME Pesticide Compounds

DATA FILE 4U10039BP03 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
NC. FACTOR _____ DATE INJECTED 11/08/82 COMPOUNDS DETECTED 0

DES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1P	89P	aldrin	ND	2P	102P	alpha BHC	ND
10P	90P	dieldrin	ND	3P	103P	beta BHC	ND
6P	91P	chlordane	ND	4P	104P	Lindane - gamma BHC	ND
7P	92P	4,4'-DDT	ND	5P	105P	delta BHC	ND
8P	93P	4,4'-DDE	ND	18P	106P	PCB-1242	ND
9P	94P	4,4'-DDD	ND	19P	107P	PCB-1254	ND
11P	95P	alpha endosulfan	ND	20P	108P	PCB-1221	ND
12P	96P	beta endosulfan	ND	21P	109P	PCB-1232	ND
14P	97P	endosulfan sulfate	ND	22P	110P	PCB-1248	ND
14P	98P	endrin	ND	23P	111P	PCB-1260	ND
15P	99P	endrin aldehyde	ND	24P	112P	PCB-1016	ND
16P	100P	heptachlor	ND	25P	113P	toxaphene	ND
17P	101P	heptachlor epoxide	ND			methoxychlor	ND

IVED: 10/21/82 RESULTS BY SAMPLE CONTINUED FROM ABOVE

LE ID TH-3 FRACTION 03A TEST CODE BPEST NAME Pesticide Compounds

following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1620	IS1P	d10-phenanthrene	10

ES AND DEFINITIONS FOR THIS REPORT.
SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
Methoxychlor is routinely searched in all Pesticide scans.
It is not a priority pollutant.
UTD = Unable to determine due to interference from unresolved components.

SAMPLE ID TH-3 FRACTION 03B TEST CODE VOA NAME Volatile Compounds

DATA FILE 4U10039V03 DATE INJECTED 10/23/82 ANALYST VL VERIFIED BY RS

CONC. FACTOR _____ COMPOUNDS DETECTED 1

NPDES	SCAN	EPA	COMPOUND	RESULT	NPDES	SCAN	EPA	COMPOUND	RESULT
1V		2V	acrolein	ND	17V		32V	1,2-dichloropropane	ND
2V		3V	acrylonitrile	ND	18V		33V	1,3-dichloropropylene	ND
3V		4V	benzene	ND	19V		38V	ethylbenzene	ND
6V		6V	carbon tetrachloride	ND	22V	62	44V	methylene chloride	30
7V		7V	chlorobenzene	ND	21V		45V	methyl chloride	ND
15V		10V	1,2-dichloroethane	ND	20V		46V	methyl bromide	ND
27V		11V	1,1,1-trichloroethane	ND	5V		47V	bromoform	ND
14V		13V	1,1-dichloroethane	ND	12V		48V	dichlorobromomethane	ND
28V		14V	1,1,2-trichloroethane	ND	30V		49V	trichlorofluoromethane	ND
23V		15V	1,1,2,2-tetrachloroethane	ND	13V		50V	dichlorodifluoromethane	ND
9V		16V	chloroethane	ND	8V		51V	chlorodibromomethane	ND
4V		17V	bis (chloromethyl) ether	ND	24V		85V	tetrachloroethylene	ND
10V		19V	2-chloroethylvinyl ether	ND	25V		86V	toluene	ND
11V		23V	chloroform	ND	29V		87V	trichloroethylene	ND
16V		29V	1,1-dichloroethylene	ND	31V		88V	vinyl chloride	ND
26V		30V	1,2-trans-dichloroethylene	ND					

EIVED: 10/21/82 RESULTS BY SAMPLE CONTINUED FROM ABOVE

PLE ID TH-3 FRACTION 03B TEST CODE VOA NAME Volatile Compounds

e following are results for inter-laboratory QA/QC for EPA Method 624.

SCAN	CODE	COMPOUND	RESULT
91	IS1V	bromochloromethane	40
247	IS2V	2-bromo-1-chloropropane	40
329	IS3V	1,4-dichlorobutane	40
131	S1V	d4-1,2-dichloroethane	110 %
356	S2V	d8-toluene	94 %
424	S3V	d10-ethylbenzene	95 %

OTES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 624, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

MPLE ID TH-4 (S-1) FRACTION 04A TEST CODE ACID NAME Acid Compounds

DATA FILE 3U10039A04 DATE EXTRACTED 10/02/82 ANALYST RS VERIFIED BY RS
NC. FACTOR _____ DATE INJECTED 11/18/82 COMPOUNDS DETECTED 0

DES	SCAN	EPA	COMPOUND	RESULT	NPDES	SCAN	EPA	COMPOUND	RESULT
11A		21A	2,4,6-trichlorophenol	ND	7A		58A	4-nitrophenol	ND
8A		22A	p-chloro-m-cresol	ND	5A		59A	2,4-dinitrophenol	ND
1A		24A	2-chlorophenol	ND	4A		60A	4,6-dinitro-o-cresol	ND
2A		31A	2,4-dichlorophenol	ND	9A		64A	pentachlorophenol	ND
3A		34A	2,4-dimethylphenol	ND	10A		65A	phenol	ND
6A		57A	2-nitrophenol	ND					

e following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1047	IS1A	d10-phenanthrene	10
56B	S1A	d4-2-nitrophenol	36 %
426	S2A	d5-phenol	17 %

TES AND DEFINITIONS FOR THIS REPORT.
SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

E 24
EIVED: 10/21/82

SPECTRIX REPORT
RESULTS BY SAMPLE

LAB # 82-10-039

PLE ID TH-4 FRACTION 04A TEST CODE BASE NAME Base Neutral Compounds

DATA FILE 4U10039BP04 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
C. FACTOR _____ DATE INJECTED 11/09/82 COMPOUNDS DETECTED 0

ES	SCAN	EPA	COMPOUND	RESULT	NPDES	SCAN	EPA	COMPOUND	RESULT
1B		1B	acenaphthene	ND	41B		61B	N-nitrosodimethylamine	ND
4B		5B	benzidine	ND	43B		62B	N-nitrosodiphenylamine	ND
6B		8B	1,2,4-trichlorobenzene	ND	42B		63B	N-nitrosodi-n-propylamine	ND
3B		9B	hexachlorobenzene	ND	13B		66B	bis(2-ethylhexyl)phthalate	ND
6B		12B	hexachloroethane	ND	15B		67B	butyl benzyl phthalate	ND
1B		18B	bis(2-chloroethyl)ether	ND	26B		68B	di-n-butyl phthalate	ND
6B		20B	2-chloronaphthalene	ND	29B		69B	di-n-octyl phthalate	ND
0B		25B	1,2-dichlorobenzene	ND	24B		70B	diethyl phthalate	ND
1B		26B	1,3-dichlorobenzene	ND	25B		71B	dimethyl phthalate	ND
2B		27B	1,4-dichlorobenzene	ND	5B		72B	benzo(a)anthracene	ND
3B		28B	3,3'dichlorobenzidine	ND	6B		73B	benzo(a)pyrene	ND
7B		35B	2,4-dinitrotoluene	ND	7B		74B	3,4-benzofluoranthene	ND
8B		36B	2,6-dinitrotoluene	ND	9B		75B	benzo(k)fluoranthene	ND
9B		37B	1,2-diphenyhydrazine	ND	18B		76B	chrysene	ND
1B		39B	fluoranthene	ND	2B		77B	acenaphthylene	ND
7B		40B	4-chlorophenyl phenyl ether	ND	3B		78B	anthracene	ND
4B		41B	4-bromophenyl phenyl ether	ND	8B		79B	benzo(ghi)perylene	ND

SAMPLE ID 4 FRACTION 04A TEST CODE BASE NAME Base Neutral Compounds

12B	42B	bis(2-chloroisopropyl)ether	ND	32B	80B	fluorene	ND
10B	43B	bis(2-chloroethoxy)methane	ND	44B	81B	phenanthrene	ND
34B	52B	hexachlorobutadiene	ND	19B	82B	dibenzo(a,h)anthracene	ND
35B	53B	hexachlorocyclopentadiene	ND	37B	83B	indeno(1,2,3-cd)pyrene	ND
38B	54B	isophorone	ND	45B	84B	pyrene	ND
39B	55B	naphthalene	ND		129B	dioxin	ND
40B	56B	nitrobenzene	ND				

The following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1620	IS1B	d10-phenanthrene	10
845	S1B	d5-2-nitrobenzene	23 %
970	S2B	d8-naphthalene	46 %
1425	S3B	d10-fluorene	61 %
2178	S4B	d12-chrysene	62 %

NOTES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

:CEIVED: 10/21/82 RESULTS [illegible] SAMPLE

:MPLE ID TH-4 FRACTION 04A TEST CODE BPEST NAME Pesticide Compounds

DATA FILE 4U10039BP04 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
)NC. FACTOR _____ DATE INJECTED 11/09/82 COMPOUNDS DETECTED 0

PDES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1P	89P	aldrin	ND	2P	102P	alpha BHC	ND
10P	90P	dieldrin	ND	3P	103P	beta BHC	ND
6P	91P	chlordane	ND	4P	104P	Lindane - gamma BHC	ND
7P	92P	4,4'-DDT	ND	5P	105P	delta BHC	ND
8P	93P	4,4'-DDE	ND	18P	106P	PCB-1242	ND
9P	94P	4,4'-DDD	ND	19P	107P	PCB-1254	ND
11P	95P	alpha endosulfan	ND	20P	108P	PCB-1221	ND
12P	96P	beta endosulfan	ND	21P	109P	PCB-1232	ND
14P	97P	endosulfan sulfate	ND	22P	110P	PCB-1248	ND
14P	98P	endrin	ND	23P	111P	PCB-1260	ND
15P	99P	endrin aldehyde	ND	24P	112P	PCB-1016	ND
16P	100P	heptachlor	ND	25P	113P	toxaphene	ND
17P	101P	heptachlor epoxide	ND			methoxychlor	ND

AMPLE ID TH-4 FRACTION 04A TEST CODE BPEST NAME Pesticide Compounds

e following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN CODE	COMPOUND	RESULT
1620 IS1P	d10-phenanthrene	10

TES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
Methoxychlor is routinely searched in all Pesticide scans.
It is not a priority pollutant.
UTD = Unable to determine due to interference from unresolved components.

AMPLE ID TH-4 FRACTION 04B TEST CODE VOA NAME Volatile Compounds

he following are results for inter-laboratory QA/QC for EPA Method 624.

SCAN	CODE	COMPOUND	RESULT
92	IS1V	bromochloromethane	40
248	IS2V	2-bromo-1-chloropropane	40
330	IS3V	1,4-dichlorobutane	40
132	S1V	d4-1,2-dichloroethane	110 %
357	S2V	d8-toluene	91 %
424	S3V	d10-ethylbenzene	92 %

OTES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 624, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

SEIVED: 1 /UE RESULTS BY FLE

MPLE ID TH-4 FRACTION 04B TEST CODE VOA NAME Volatile Compounds

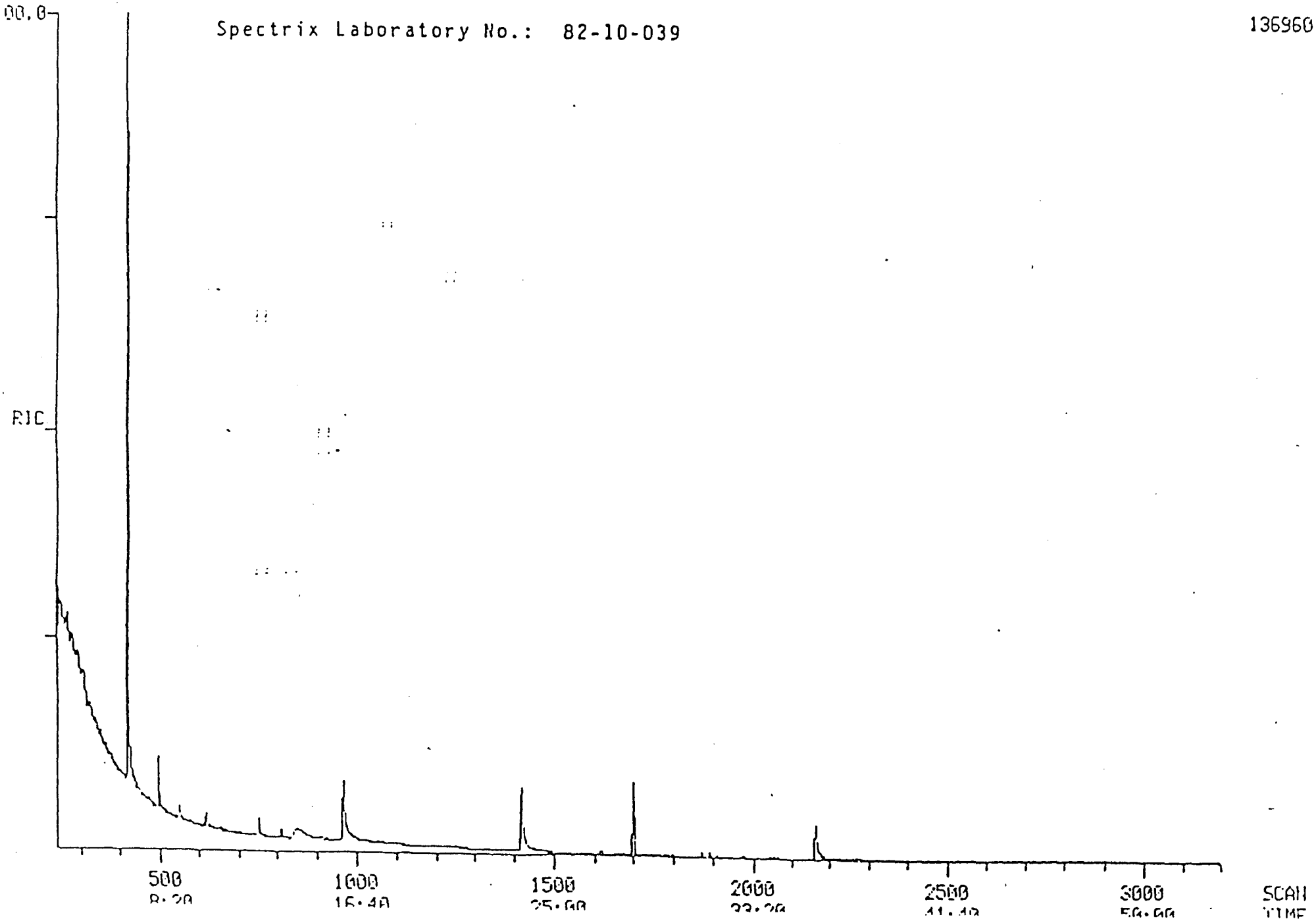
DATA FILE 4U10039V04 DATE INJECTED 10/23/82 ANALYST VL VERIFIED BY RS
NC. FACTOR _____ COMPOUNDS DETECTED 0

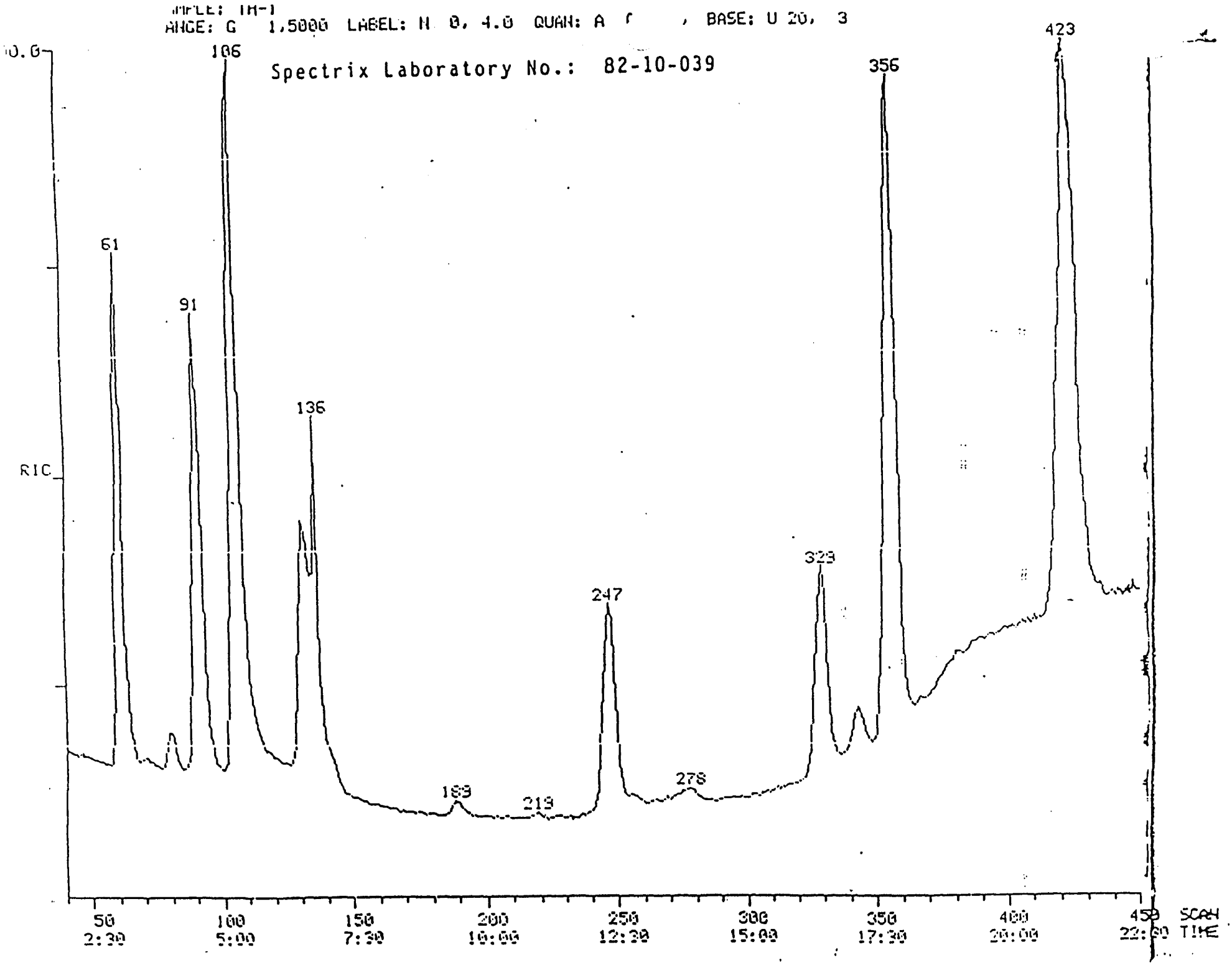
DES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1V	2V	acrolein	ND	17V	32V	1,2-dichloropropane	ND
2V	3V	acrylonitrile	ND	18V	33V	1,3-dichloropropylene	ND
3V	4V	benzene	ND	19V	38V	ethylbenzene	ND
6V	6V	carbon tetrachloride	ND	22V	44V	methylene chloride	ND
7V	7V	chlorobenzene	ND	21V	45V	methyl chloride	ND
15V	10V	1,2-dichloroethane	ND	20V	46V	methyl bromide	ND
27V	11V	1,1,1-trichloroethane	ND	5V	47V	bromoform	ND
14V	13V	1,1-dichloroethane	ND	12V	48V	dichlorobromomethane	ND
28V	14V	1,1,2-trichloroethane	ND	30V	49V	trichlorofluoromethane	ND
23V	15V	1,1,2,2-tetrachloroethane	ND	13V	50V	dichlorodifluoromethane	ND
9V	16V	chloroethane	ND	8V	51V	chlorodibromomethane	ND
4V	17V	bis (chloromethyl) ether	ND	24V	85V	tetrachloroethylene	ND
10V	19V	2-chloroethylvinyl ether	ND	25V	86V	toluene	ND
11V	23V	chloroform	ND	29V	87V	trichloroethylene	ND
16V	29V	1,1-dichloroethylene	ND	31V	88V	vinyl chloride	ND
26V	30V	1,2-trans-dichloroethylene	ND				

RIC
11/08/82 14:43:00
SAMPLE: TH-1
RANGE: G 1,3600 LABEL: N 0, 4.0 QUAN: A 0, 1.0 BASE: U 20, 3

DATA: 4U10039BF01 #10
CALI: 4C110882 #3

SCANS 240 . 200




ANGE: G 1,5000 LABEL: N 0, 4.0 QUAN: A , BASE: U 20, 3
Spectrix Laboratory No.: 82-10-039
RIC
61
91
106
136
183
219
247
278
329
356
423
50
2:30
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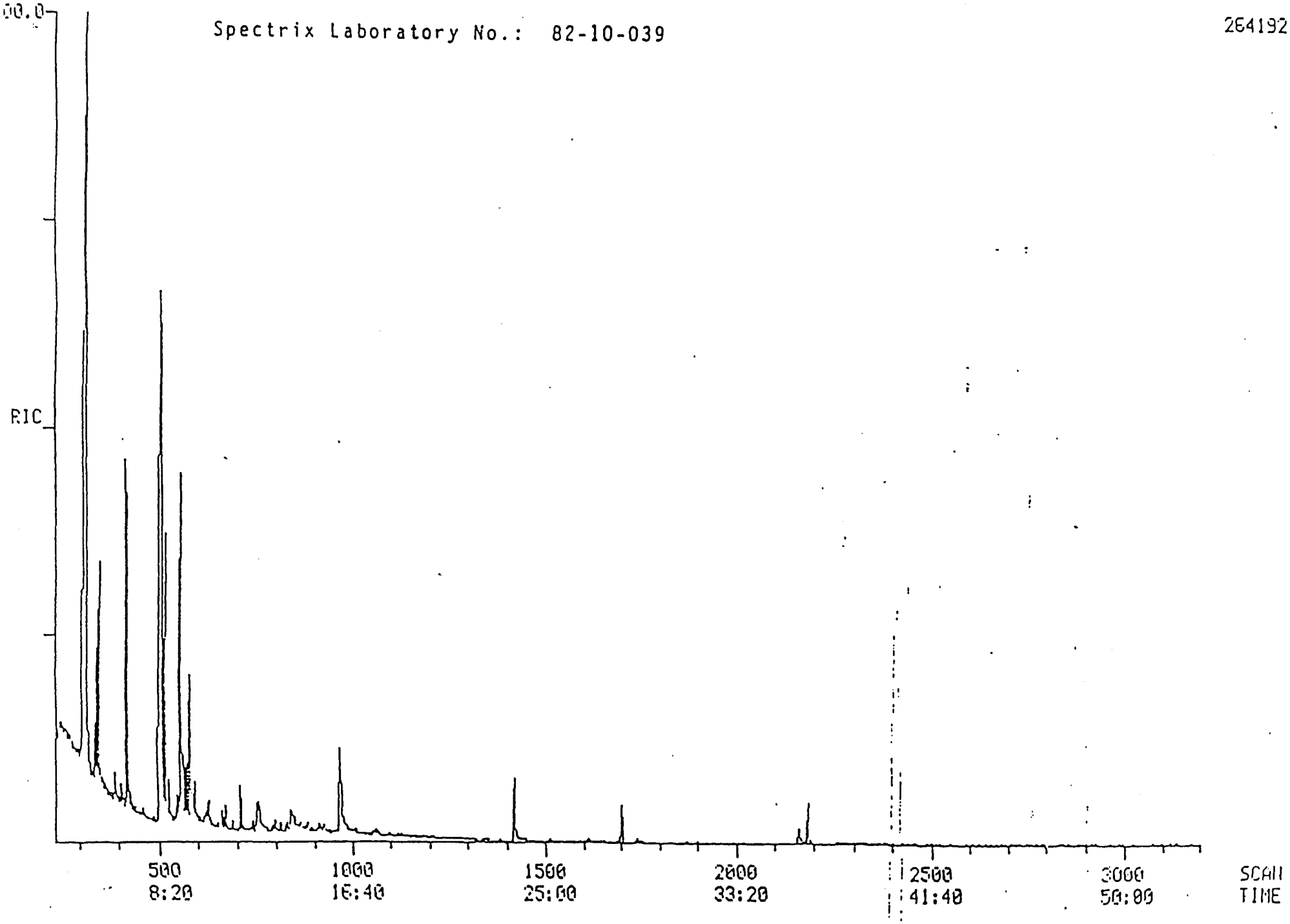
5:00
150
7:30
200
10:00
250
12:30
300
15:00
350
17:30
400
20:00
450
22:30
SCAN
TIME

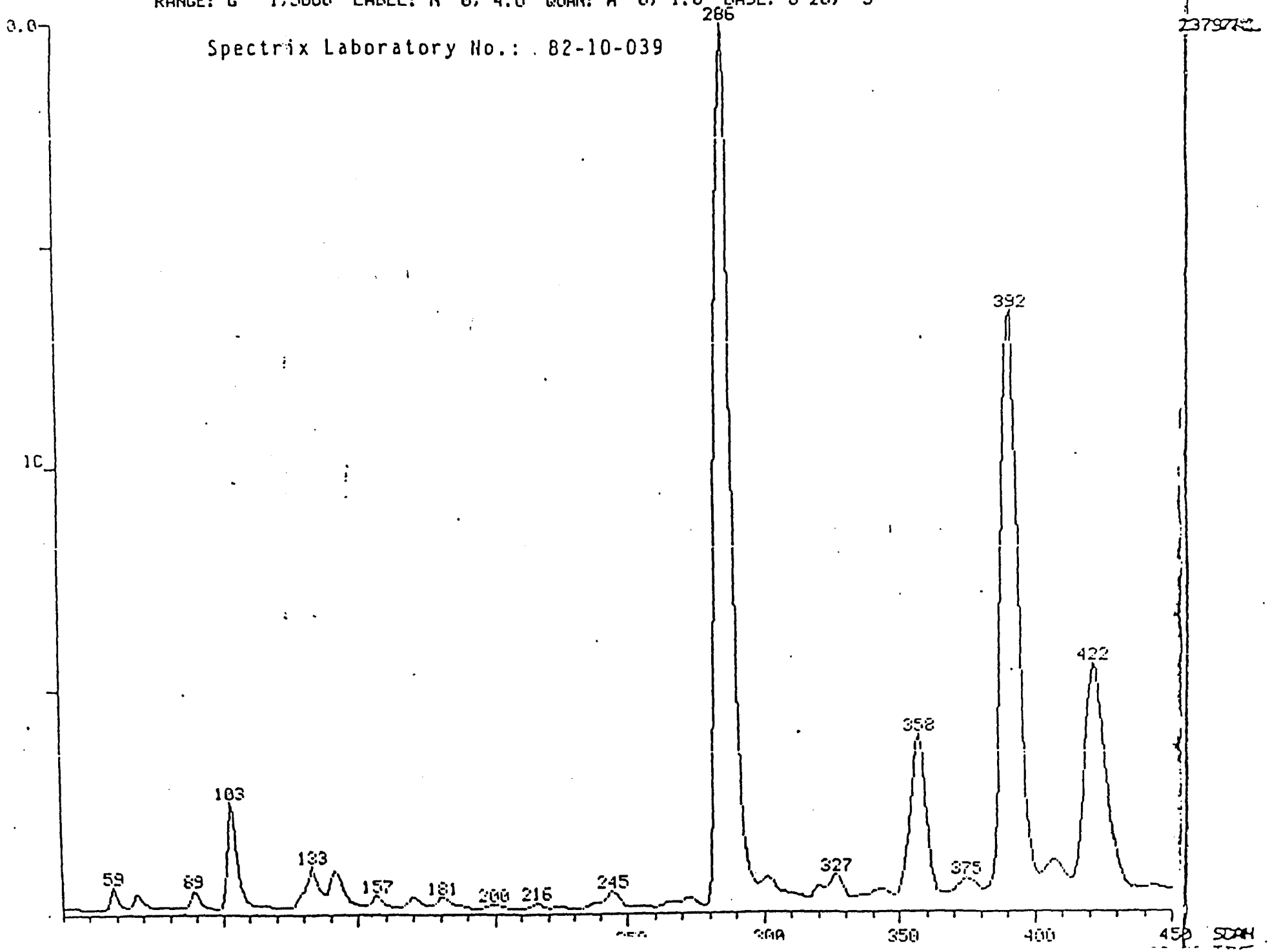
SAMPLE: TH-2
RANGE: G 1,3600 LABEL: N 0, 4.0 QUAN: A 0, 1.0 BASE: U 20, 3

Spectrix Laboratory No.: 82-10-039

264192



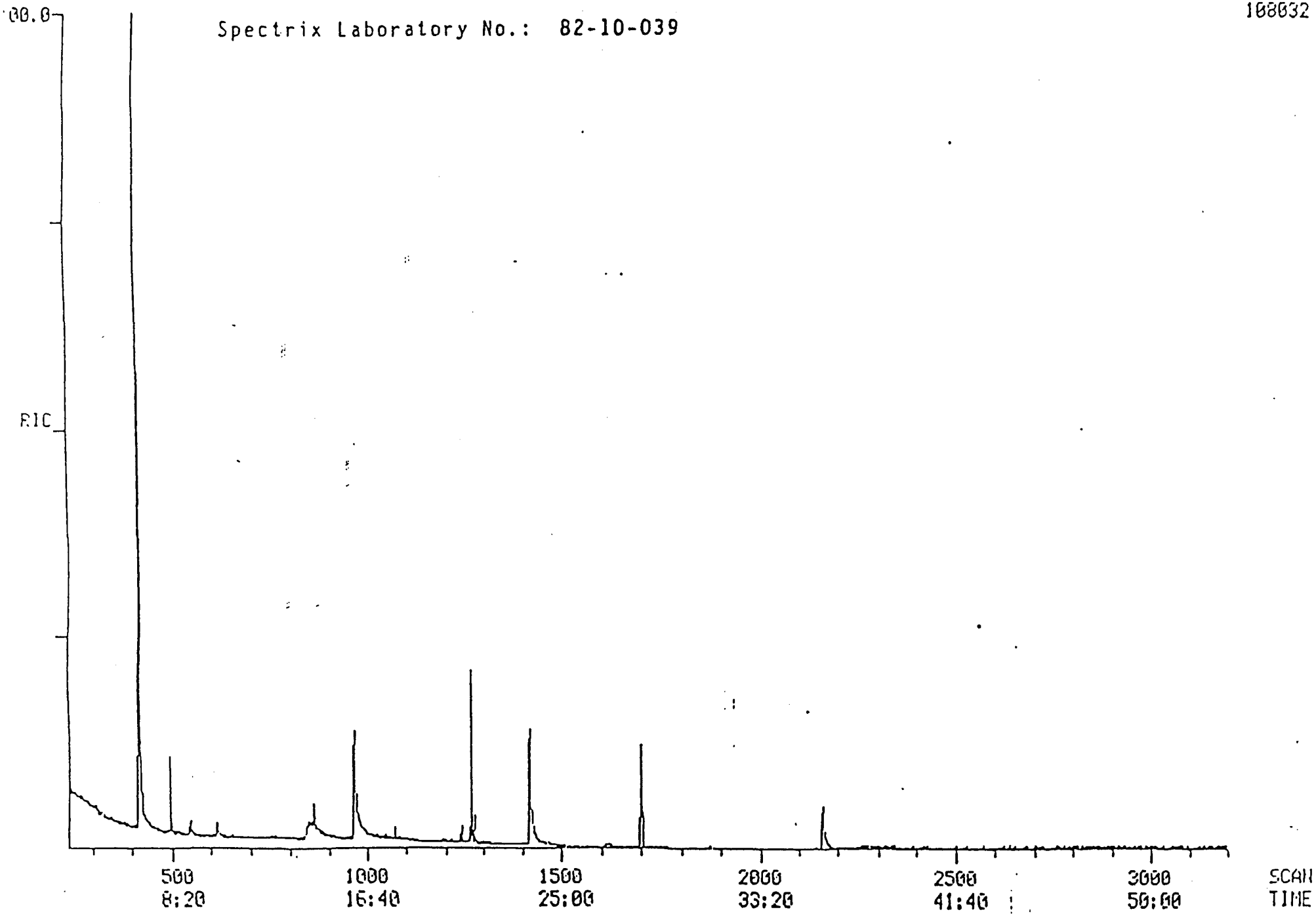
SAMPLE: TH-2
RANGE: G 1,5000 LABEL: N 0, 4.0 QUAN: H 0, 1.0 BASE: U 20, 3



SAMPLE: TH-3
RANGE: G 1,3600 LABEL: N 0, 4.0 QUAN: A 0, 1.0 BASE: U 20, 3

108032

Spectrix Laboratory No.: 82-10-039

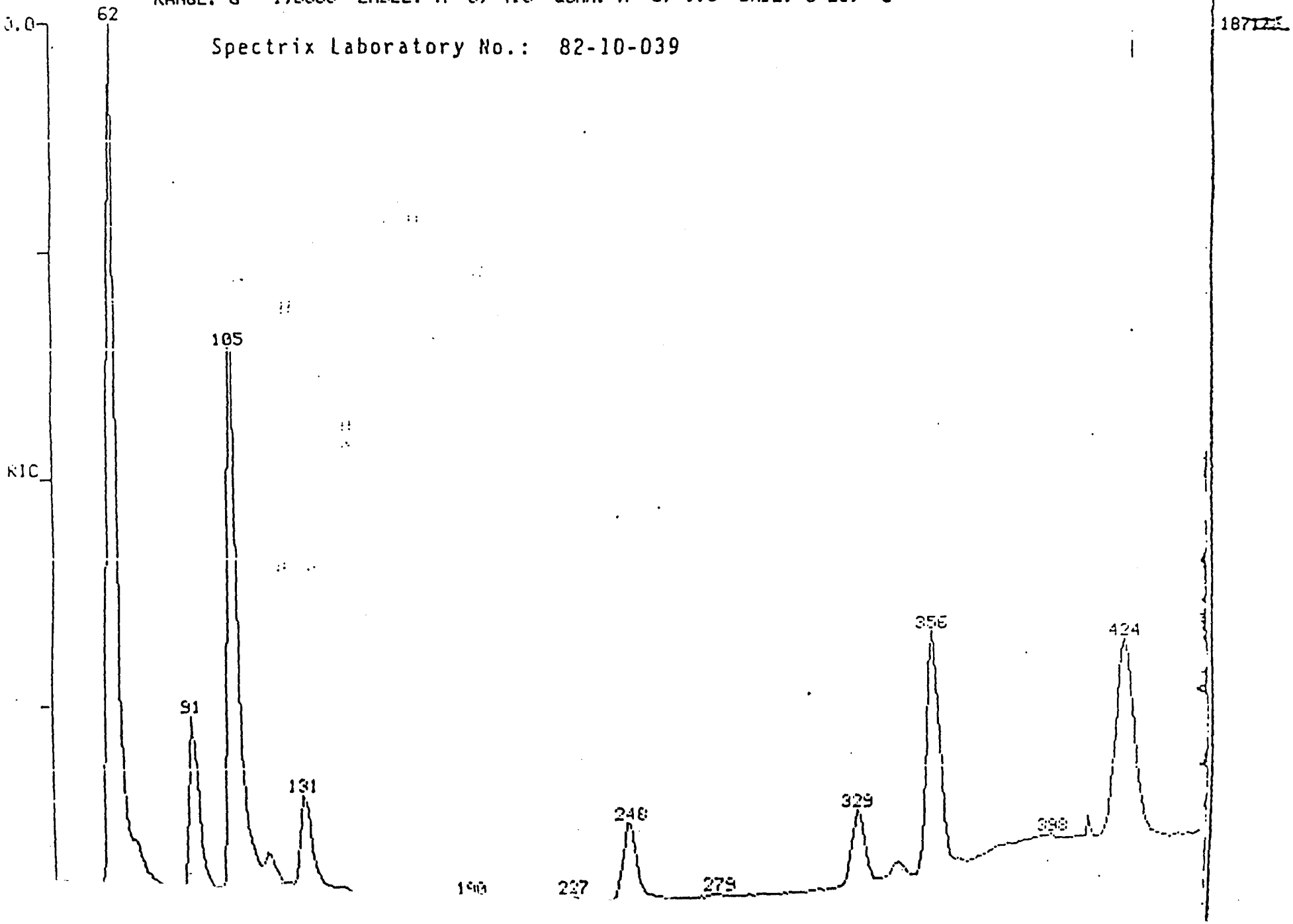


RIC
10/23/82 15:52:00
SAMPLE: TH-3
RANGE: G 1,5000 LABEL: N 0, 4.0 QUAN: A 0, 1.0 BASE: U 20, 3

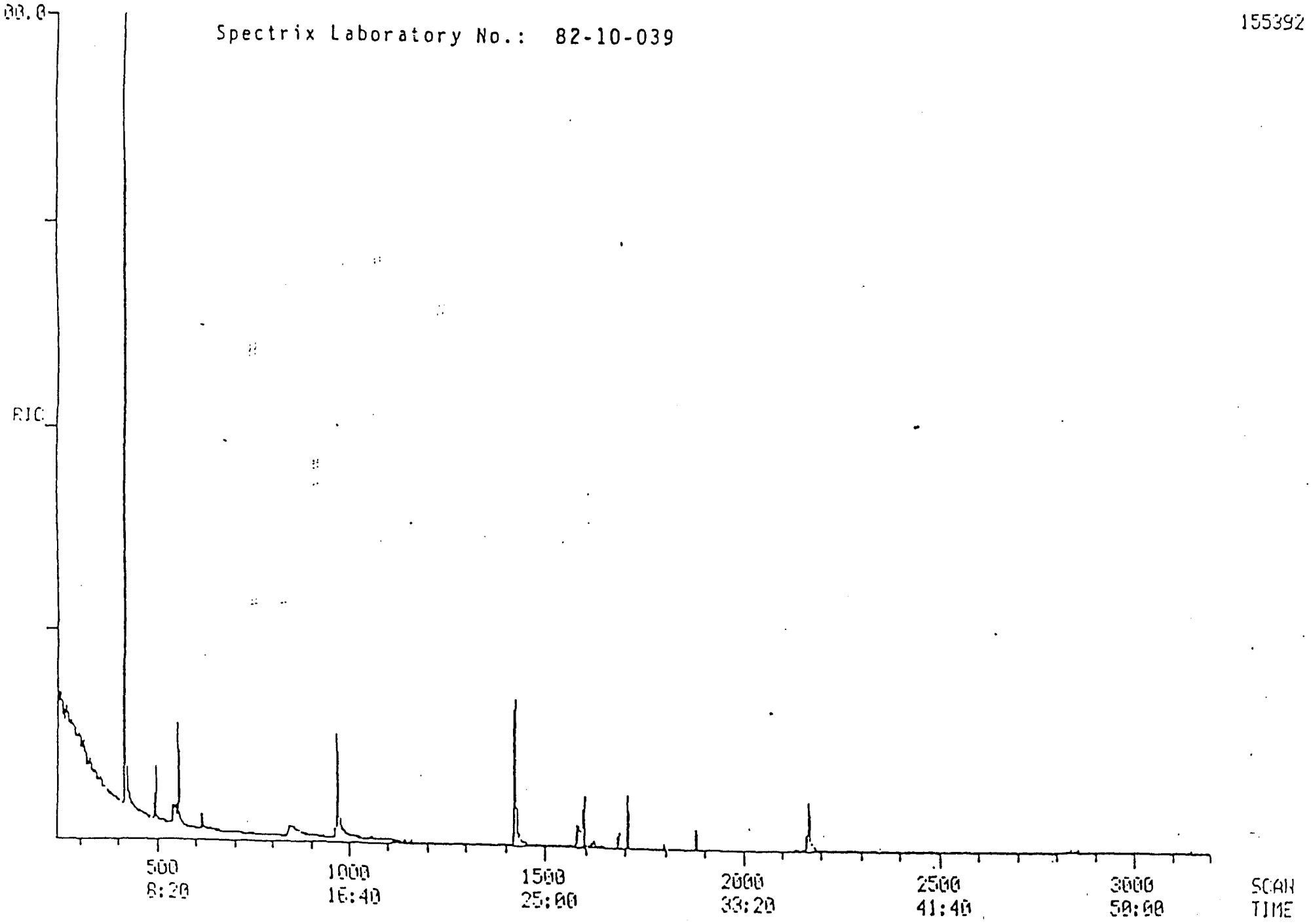
DATA: 4U16039U03 #1
CAL1: 4C102382 #3

SCANS 40 TO 4

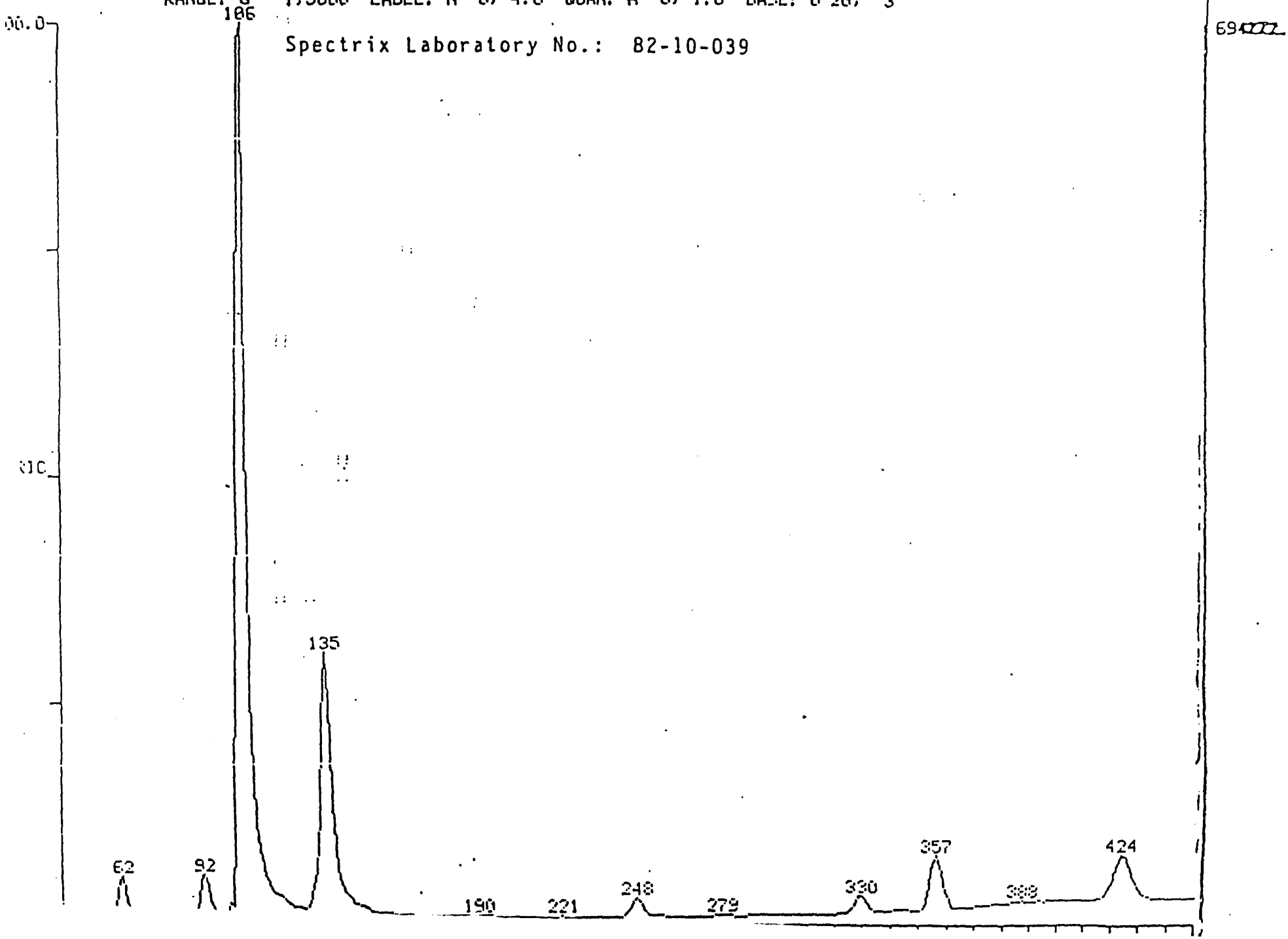
Spectrix Laboratory No.: 82-10-039



11/09/82 10:11:00 CAL1: 4C110982 #3
SAMPLE: TH-4
RANGE: G 1,3600 LABEL: N 0, 4.0 QUAN: A 0, 1.0 BASE: U 20, 3



10/23/82 16:24:00 CAL1: 4C102382 #3
SAMPLE: TH-4
RANGE: G 1.5000 LABEL: N 0, 4.0 QUAN: A 0, 1.0 BASE: U 20, 3



SPECTRIX REPORT

LAB # 82-10-034

CEIVED: 10/21/82

RESULTS BY SAMPLE

MPLE ID TH-1 (W-1B) FRACTION 01A TEST CODE ACID NAME Acid Compounds

DATA FILE 3U10039A01 DATE EXTRACTED 10/26/82 ANALYST VL VERIFIED BY RS

ONC. FACTOR _____ DATE INJECTED 11/18/82 COMPOUNDS DETECTED 0

PDES	SCAN	EPA	COMPOUND	RESULT	NPDES	SCAN	EPA	COMPOUND	RESULT
11A		21A	2,4,6-trichlorophenol	ND	7A		58A	4-nitrophenol	ND
8A		22A	p-chloro-m-cresol	ND	5A		59A	2,4-dinitrophenol	ND
1A		24A	2-chlorophenol	ND	4A		60A	4,6-dinitro-o-cresol	ND
2A		31A	2,4-dichlorophenol	ND	9A		64A	pentachlorophenol	ND
3A		34A	2,4-dimethylphenol	ND	10A		65A	phenol	ND
6A		57A	2-nitrophenol	ND					

he following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1047	IS1A	d10-phenanthrene	10
567	S1A	d4-2-nitrophenol	37 %
425	S2A	d5-phenol	26 %

OTES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

PLE ID TH-1 FRACTION 01A TEST CODE BASE NAME Base Neutral Compounds

DATA FILE 4U10039BP01 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
C. FACTOR _____ DATE INJECTED 11/08/82 COMPOUNDS DETECTED 0

ES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1B	1B	acenaphthene	ND	41B	61B	N-nitrosodimethylamine	ND
4B	5B	benzidine	ND	43B	62B	N-nitrosodiphenylamine	ND
16B	8B	1,2,4-trichlorobenzene	ND	42B	63B	N-nitrosodi-n-propylamine	ND
33B	9B	hexachlorobenzene	ND	13B	66B	bis(2-ethylhexyl)phthalate	ND
36B	12B	hexachloroethane	ND	15B	67B	butyl benzyl phthalate	ND
11B	18B	bis(2-chloroethyl)ether	ND	26B	68B	di-n-butyl phthalate	ND
16B	20B	2-chloronaphthalene	ND	29B	69B	di-n-octyl phthalate	ND
20B	25B	1,2-dichlorobenzene	ND	24B	70B	diethyl phthalate	ND
21B	26B	1,3-dichlorobenzene	ND	25B	71B	dimethyl phthalate	ND
22B	27B	1,4-dichlorobenzene	ND	5B	72B	benzo(a)anthracene	ND
23B	28B	3,3'dichlorobenzidine	ND	6B	73B	benzo(a)pyrene	ND
27B	35B	2,4-dinitrotoluene	ND	7B	74B	3,4-benzofluoranthene	ND
28B	36B	2,6-dinitrotoluene	ND	9B	75B	benzo(k)fluoranthene	ND
29B	37B	1,2-diphenyhydrazine	ND	18B	76B	chrysene	ND
31B	39B	fluoranthene	ND	2B	77B	acenaphthylene	ND
17B	40B	4-chlorophenyl phenyl ether	ND	3B	78B	anthracene	ND
14B	41B	4-bromophenyl phenyl ether	ND	8B	79B	benzo(ghi)perylene	ND

IPLE ID TH-1 FRACTION 01A TEST CODE BASE NAME Base Neutral Compounds

12B	42B	bis(2-chloroisopropyl)ether	ND	32B	80B	fluorene	ND
10B	43B	bis(2-chloroethoxy)methane	ND	44B	81B	phenanthrene	ND
34B	52B	hexachlorobutadiene	ND	19B	82B	dibenzo(a,h)anthracene	ND
35B	53B	hexachlorocyclopentadiene	ND	37B	83B	indeno(1,2,3-cd)pyrene	ND
38B	54B	isophorone	ND	45B	84B	pyrene	ND
39B	55B	naphthalene	ND		129B	dioxin	ND
40B	56B	nitrobenzene	ND				

e following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1617	IS1B	d10-phenanthrene	10
852	S1B	d5-2-nitrobenzene	32 %
968	S2B	d8-naphthalene	40 %
1420	S3B	d10-fluorene	49 %
2163	S4B	d12-chrysene	71 %

OTES AND DEFINITIONS FOR THIS REPORT.
SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

SAMPLE ID TH-1 FRACTION 01A TEST CODE BPEST NAME Pesticide Compounds

DATA FILE 4U10039BP01 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
CONC. FACTOR _____ DATE INJECTED 11/08/82 COMPOUNDS DETECTED 0

NPDES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1P	89P	aldrin	ND	2P	102P	alpha BHC	ND
10P	90P	dieldrin	ND	3P	103P	beta BHC	ND
6P	91P	chlordane	ND	4P	104P	Lindane - gamma BHC	ND
7P	92P	4,4'-DDT	ND	5P	105P	delta BHC	ND
8P	93P	4,4'-DDE	ND	18P	106P	PCB-1242	ND
9P	94P	4,4'-DDD	ND	19P	107P	PCB-1254	ND
11P	95P	alpha endosulfan	ND	20P	108P	PCB-1221	ND
12P	96P	beta endosulfan	ND	21P	109P	PCB-1232	ND
14P	97P	endosulfan sulfate	ND	22P	110P	PCB-1248	ND
14P	98P	endrin	ND	23P	111P	PCB-1260	ND
15P	99P	endrin aldehyde	ND	24P	112P	PCB-1016	ND
16P	100P	heptachlor	ND	25P	113P	toxaphene	ND
17P	101P	heptachlor epoxide	ND			methoxychlor	ND

IPLE ID TH-1 FRACTION 01A TEST CODE BPEST NAME Pesticide Compounds

: following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1617	IS1P	d10-phenanthrene	10

TES AND DEFINITIONS FOR THIS REPORT.
SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
Methoxychlor is routinely searched in all Pesticide scans.
It is not a priority pollutant.
UTD = Unable to determine due to interference from unresolved components.

AMPLE ID TH-1 FRACTION 01B TEST CODE VOA NAME Volatile Compounds

DATA FILE 4U10039V01 DATE INJECTED 10/23/82 ANALYST VL VERIFIED BY RS

DNC. FACTOR _____ COMPOUNDS DETECTED 0

PDES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1V	2V	acrolein	ND	17V	32V	1,2-dichloropropane	ND
2V	3V	acrylonitrile	ND	18V	33V	1,3-dichloropropylene	ND
3V	4V	benzene	ND	19V	38V	ethylbenzene	ND
6V	6V	carbon tetrachloride	ND	22V	44V	methylene chloride	ND
7V	7V	chlorobenzene	ND	21V	45V	methyl chloride	ND
15V	10V	1,2-dichloroethane	ND	20V	46V	methyl bromide	ND
27V	11V	1,1,1-trichloroethane	ND	5V	47V	bromoform	ND
14V	13V	1,1-dichloroethane	ND	12V	48V	dichlorobromomethane	ND
28V	14V	1,1,2-trichloroethane	ND	30V	49V	trichlorofluoromethane	ND
23V	15V	1,1,2,2-tetrachloroethane	ND	13V	50V	dichlorodifluoromethane	ND
9V	16V	chloroethane	ND	8V	51V	chlorodibromomethane	ND
4V	17V	bis (chloromethyl) ether	ND	24V	85V	tetrachloroethylene	ND
10V	19V	2-chloroethylvinyl ether	ND	25V	86V	toluene	ND
11V	23V	chloroform	ND	29V	87V	trichloroethylene	ND
16V	29V	1,1-dichloroethylene	ND	31V	88V	vinyl chloride	ND
26V	30V	1,2-trans-dichloroethylene	ND				

:EIVED: 10/21/82 RESULTS BY SAMPLE CONTINUED FROM

1PLE ID TH-1 FRACTION 01B TEST CODE VOA NAME Volatile Compounds

e following are results for inter-laboratory QA/QC for EPA Method 624.

SCAN	CODE	COMPOUND	RESULT
91	IS1V	bromochloromethane	40
247	IS2V	2-bromo-1-chloropropane	40
329	IS3V	1,4-dichlorobutane	40
131	S1V	d4-1,2-dichloroethane	110 %
356	S2V	d8-toluene	92 %
423	S3V	d10-ethylbenzene	94 %

OTES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 624, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

PLE ID TH-2 (N-1) FRACTION 02A TEST CODE ACID NAME Acid Compounds

DATA FILE 3U10039A02 DATE EXTRACTED 10/26/82 ANALYST VL VERIFIED BY RS
C. FACTOR _____ DATE INJECTED 11/18/82 COMPOUNDS DETECTED 0

DES	SCAN	EPA	COMPOUND	RESULT	NPDES	SCAN	EPA	COMPOUND	RESULT
1A		21A	2,4,6-trichlorophenol	ND	7A		58A	4-nitrophenol	ND
8A		22A	p-chloro-m-cresol	ND	5A		59A	2,4-dinitrophenol	ND
1A		24A	2-chlorophenol	ND	4A		60A	4,6-dinitro-o-cresol	ND
2A		31A	2,4-dichlorophenol	ND	9A		64A	pentachlorophenol	ND
3A		34A	2,4-dimethylphenol	ND	10A		65A	phenol	ND
6A		57A	2-nitrophenol	ND					

e following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1047	IS1A	d10-phenanthrene	10
568	S1A	d4-2-nitrophenol	72 %
427	S2A	d5-phenol	52 %

TES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

.IVED: 10. 2 RESULTS BY: --

'LE ID TH-2 FRACTION 02A TEST CODE BASE NAME Base Neutral Compounds

:B	42B	bis(2-chloroisopropyl)ether	ND	32B	80B	fluorene	ND
)B	43B	bis(2-chloroethoxy)methane	ND	44B	81B	phenanthrene	ND
)B	52B	hexachlorobutadiene	ND	19B	82B	dibenzo(a,h)anthracene	ND
)B	53B	hexachlorocyclopentadiene	ND	37B	83B	indeno(1,2,3-cd)pyrene	ND
3B	54B	isophorone	ND	45B	84B	pyrene	ND
?B	55B	naphthalene	ND		129B	dioxin	ND
)B	56B	nitrobenzene	ND				

following are results for inter-laboratory QA/QC for EPA Method 625.

SCAN	CODE	COMPOUND	RESULT
1615	IS1B	d10-phenanthrene	10
841	S1B	d5-2-nitrobenzene	63 %
969	S2B	d8-naphthalene	74 %
1420	S3B	d10-fluorene	53 %
2162	S4B	d12-chrysene	47 %

ES AND DEFINITIONS FOR THIS REPORT.

SCAN = scan number on chromatogram.
All results reported in micrograms/liter unless otherwise specified.
ND = not detected at EPA detection limit method 625, (Federal Register, 12/3/79).
IS = Internal Standard for quantitation.
S = Surrogate Compound added for recovery checks.
UTD = Unable to determine due to interference from unresolved components.

EIVED: 10/21/82

RESULTS BY SAMPLE

PLE ID TH-2 FRACTION 02A TEST CODE BASE NAME Base Neutral Compounds

DATA FILE 4U1039BP02 DATE EXTRACTED 10/25/82 ANALYST VL VERIFIED BY RS
C. FACTOR _____ DATE INJECTED 11/08/82 COMPOUNDS DETECTED 1

ES SCAN	EPA	COMPOUND	RESULT	NPDES SCAN	EPA	COMPOUND	RESULT
1B	1B	acenaphthene	ND	41B	61B	N-nitrosodimethylamine	ND
4B	5B	benzidine	ND	43B	62B	N-nitrosodiphenylamine	ND
6B	8B	1,2,4-trichlorobenzene	ND	42B	63B	N-nitrosodi-n-propylamine	ND
33B	9B	hexachlorobenzene	ND	13B 21B5	66B	bis(2-ethylhexyl)phthalate	100
36B	12B	hexachloroethane	ND	15B	67B	butyl benzyl phthalate	ND
11B	18B	bis(2-chloroethyl)ether	ND	26B	68B	di-n-butyl phthalate	ND
16B	20B	2-chloronaphthalene	ND	29B	69B	di-n-octyl phthalate	ND
20B	25B	1,2-dichlorobenzene	ND	24B	70B	diethyl phthalate	ND
21B	26B	1,3-dichlorobenzene	ND	25B	71B	dimethyl phthalate	ND
22B	27B	1,4-dichlorobenzene	ND	5B	72B	benzo(a)anthracene	ND
23B	28B	3,3'dichlorobenzidine	ND	6B	73B	benzo(a)pyrene	ND
27B	35B	2,4-dinitrotoluene	ND	7B	74B	3,4-benzofluoranthene	ND
28B	36B	2,6-dinitrotoluene	ND	9B	75B	benzo(k)fluoranthene	ND
29B	37B	1,2-diphenyhydrazine	ND	18B	76B	chrysene	ND
31B	39B	fluoranthene	ND	2B	77B	acenaphthylene	ND
17B	40B	4-chlorophenyl phenyl ether	ND	3B	78B	anthracene	ND
14B	41B	4-bromophenyl phenyl ether	ND	8B	79B	benzo(ghi)perylene	ND

SIRRINE
ENVIRONMENTAL CONSULTANTS

December 19, 1983

Mr. Richard J. McDonald
Singer Furniture
Post Office Box 1588
Lenoir, North Carolina 28645

Subject: Landfill Investigation
Report (Phase II)
Singer Furniture
Lenoir, North Carolina
Sirrine Job No. F-1003

Dear Mr. McDonald:

As requested by Singer Furniture, we have prepared this Landfill Investigation Report (Phase II) concerning the abandoned site near Plant No. 3.

We are available to discuss this report with you and appreciate the opportunity of preparing it.

Very truly yours,

J. E. SIRRINE COMPANY

Jim Brooks

J. R. Brooks

s/b

Enclosure

Sirrine Environmental Consultants, Inc.
Post Office Box 5456, Greenville, South Carolina 29606
Telephone 803 [illegible]

SIRRINE

LANDFILL INVESTIGATION

REPORT

PHASE II

SINGER FURNITURE

PLANT NO. 3

LENOIR,

NORTH CAROLINA

DECEMBER 19, 1983

SIRRINE ENVIRONMENTAL CONSULTANTS

JOB NO. F-1003

J. E. SIRRINE COMPANY
ENGINEERS
SOUTH CAROLINA DIVISION
GREENVILLE, SOUTH CAROLINA

SIRRINE

Phase II
Landfill Investigation
Singer Furniture

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SIRRINE

Phase II
Landfill Investigation
Singer Furniture

A. INTRODUCTION

J. E. Sirrine Company was retained by Singer Furniture to conduct a Phase II Landfill Investigation at Plant No. 3 in Lenoir, North Carolina.

The Phase I Landfill Investigation was conducted in October, 1982. This study revealed that certain chemicals, known to have been disposed in the landfill, have migrated into the groundwater in the immediate vicinity of the landfill. The purpose of the Phase II Landfill Investigation was: to determine the down-gradient extent of contamination in the alluvial floodplain of Lower Creek; and to evaluate the hydrogeologic properties of the alluvial floodplain, i.e., the direction and rate of groundwater movement.

To accomplish the above described project scope, three monitoring wells were installed during the Phase II study to complement four wells installed during Phase I. Only one of the Phase I wells was found to contain organic or metal priority pollutants in measurable quantities. Well N-1, located within 100 feet of the north slope of the landfill, contained ethylbenzene (55 ug/l), toluene (166 ug/l), and Bis (2-ethlyhexyl) phthalate (100 ug/l). In addition, the metals arsenic, chromium, lead, and barium were detected in concentrations exceeding the primary drinking water standards.

The Phase II monitoring wells were installed at greater distances from the landfill to determine if a contaminant plume exists and, its horizontal and vertical extent (Figure 1). The additional three Phase II wells also enabled a more precise groundwater flow rate and direction to be calculated.

A. INTRODUCTION - continued

This Phase II investigation represents a refinement of the data and conclusions reached during Phase I. This report contains recommendations for the continued evaluation of groundwater quality down-grade of the landfill utilizing the existing monitoring network of seven wells. The Phase I report should be used as a reference for background material. The Soil & Material Engineers' Phase II Hydrogeologic Investigation is included as Appendix 1.

B. SUMMARY

The landfill site had been used by the City of Lenoir for municipal/industrial refuse disposal and subsequently by Magnavox and Singer Furniture. There is no record of the types and quantities of chemicals buried at the site, but it is known that Singer Furniture disposed of organic solvents, varnish, lacquers, paints, and other chemicals associated with the production and finishing of furniture. A portion of the material was buried in drums and the remainder disposed in bulk or burned in pits.

The Phase I investigation revealed that leachate, containing some of the materials described above, has migrated a short distance from the landfill. Certain solvents and metals were detected in Well N-1 located just less than 100 feet from the north slope of the fill. The wells installed to the east and west of the landfill were essentially free of priority pollutant organics and metals.

Phase II involved the installation of three additional wells at greater distances east, north, and west of the landfill. The Phase II wells were installed closer to Lower Creek, which is the major drainage feature of the area. All three Phase II wells were found to be essentially free of priority pollutant solvents and metals. This information indicates that the source of the chemicals detected in Well N-1 may not be large enough for significant quantities of organics or metals to be found several hundred feet downgrade of the landfill. Dispersion of a relatively small contaminant source could dilute the concentration of organics and metals found in Well N-1 to below the detection limit in a short distance.

B. SUMMARY - continued

An area well survey was conducted to determine if any residences or businesses are currently utilizing groundwater as a potable source. It was determine that several residences along Virginia Street, bordering the lumber yard on the east side of Plant No. 3, currently use groundwater as a drinking water source. The residential wells are all shallow and tap the saprolite zone.

The landfill is located 600-1000 feet from the Virginia Street residences in the down-grade direction. In addition, water level measurements taken in these residential wells and the seven groundwater monitoring wells conclusively show the area groundwater movement to be toward Lower Creek. Therefore, any leachate from the landfill would move away from the Virginia Street residences north and west toward Lower Creek.

SIRRINE

Phase II
Landfill Investigation
Singer Furniture

C. ANALYTICAL SUMMARY

Groundwater samples were taken from the three Phase II monitoring wells on August 8, 1983. Environmental Testing and Certification Corporation (ETC), of Edison, New Jersey, performed the organic priority pollutant analysis and the J. E. Sirrine Company laboratory performed additional analysis for specific ions, solids, TOC, pH, and specific conductivity. The Phase II groundwater analyses are presented in Appendix 2.

The priority pollutants detected are listed below. Significant concentrations of metals are also listed.

Phase I Wells

Monitoring Well	Parameter	Concentration (ug/l)	Primary Drinking Water Standards (ug/l)	Detection Limit (ug/l)
S-1	No Organics			
W-1B	No Organics			
E-1	Methylene Chloride	30		10
N-1	Ethlybenzene	55		10
	Toluene	166		10
	Bis (2-ethylhexyl) Phthalate	100		10
	Nickel	230		
	Arsenic	93	50	
	Beryllium	56		
	Cadmium	6.8	10	
	Chromium	400	50	
	Copper	650		
	Lead	600	50	
	Selenium	3.0	10	
	Barium	6,100	1000	

C. ANALYTICAL SUMMARY - continued

Phase II Wells

Monitoring Well	Parameter	Concentration (ug/l)	Primary Drinking Water Standards (ug/l)	Detection Limit (ug/l)
NE-1	Methylene Chloride	16		10
W-2	No Organics			
N-2	No Organics			

The volatile organic compounds and metals were detected at N-1 (Phase I). Well N-2 (Phase II) was placed approximately 400 feet northwest of N-1 specifically to determine if these compounds have migrated. No organics were detected at N-2. In addition, no metals were detected above expected background concentrations.

Methylene chloride was detected in Well E-1 (Phase I) at a low concentration (30 ug/l). Methylene chloride was also detected at NE-1 (Phase II) at a concentration of 16 ug/l. The detection of this compound, only in these two wells on the east side of the property, is not considered significant because of the very low concentrations involved and the absence of other detectable compounds.

TEMP

SIRINE

Phase II
Landfill Investigation
Singer Furniture

D. CONCLUSIONS AND RECOMMENDATIONS

1. Conclusions

1. Certain solvents, varnish, lacquers, and paints have been disposed in the landfill adjacent to Plant No. 3.

2. Certain volatile organics and metals were detected in Well N-1 (Phase I) located near the north face of the landfill.

3. The other Phase I wells, S-1 (background), E-1, and W-1B, did not contain organics or metals of significance.

4. Phase II wells, N-2, W-2, and NE-1, were located further from the landfill to determine if contaminants found in N-1 have migrated.

5. No organics, except 16 ug/l methylene chloride in NE-1, or metals were detected in the Phase II wells.

6. The analytical data collected from the seven monitoring wells does not indicate that contaminant material had migrated significantly from the landfill.

7. From the data collected, it appears that the leachate of organic solvents and metals (Well N-1) is eminating from a very small sector of the landfill. The volume of material detected in Well N-1 may be so limited that down-gradient dispersion in the floodplain alluvium may be diluting these constituents to below the level of detection.

D. CONCLUSIONS AND RECOMMENDATIONS - continued

1. Conclusions - continued

8. The hydrogeologic investigation has determined that the Lower Creek floodplain alluvium is generally relatively permeable, but beds of low-permeability silts and clays are present which may moderate the lateral dispersion of contaminants relative to the actual rate of groundwater movement.

9. The direction of groundwater movement beneath the landfill and in the immediate area is to the north-northwest toward Lower Creek.

10. No water supply wells are threatened by the migration of landfill leachate. The direction of groundwater movement would disperse any landfill contaminant toward Lower Creek and away from the wells located along Virginia Street.

11. Based on one round of sampling and analysis at each monitoring well, there appears to be no threat presented to shallow groundwater resources in the immediate area surrounding the landfill. The hydrogeological report identifies Lower Creek as the local discharge point. Therefore, contamination of deep groundwater resources is unlikely.

2. Recommendations

1. Additional water quality data be periodically collected from the existing well network to monitor the possible movement of contaminants from the immediate area of Well N-1.

D. CONCLUSIONS AND RECOMMENDATIONS - continued

2. Recommendations - continued

2. The seven existing monitoring wells should be sampled and analyzed semi-annually for a minimum of two years to establish analytical trends with respect to the number of constituents detected and their concentrations. May now drop background well & making six wells. Can drop positive run metals & volatiles, acid compounds, ba

3. Should groundwater conditions remain approximately constant or improve, particularly at Well N-1, annual sampling and analysis may be justified after the first two years. $500/ $1000 $3500

4. The analysis of groundwater samples during the initial two year period should include the full priority pollutant list. Should the data collected during this two year period indicate improving groundwater conditions, the parameters to be analyzed could be reduced to particular fractions of the priority pollutants or indicator constituents.

5. The depth to groundwater should be measured at each of the seven wells on a quarterly basis to refine the calculation for hydraulic gradient.

PHASE II
HYDROGEOLOGIC INVESTIGATION
of the
CLOSED LANDFILL AREA
THE SINGER COMPANY
PLANT NO. 3

for

J. E. Sirrine Company, Inc.
Post Office Box 5456
216 South Pleasantburg Drive
Greenville, South Carolina

and

The Singer Company
Post Office Box 1588
Lenoir, North Carolina

Curtis L. Gorman
Project Hydrogeologist
Columbia, South Carolina

B.C. Spigner, PG
Senior Hydrogeologist
Columbia, South Carolina

SOIL & MATERIAL ENGINEERS, INC.

Report No. 04482-129A

November 21, 1983

SOIL & MATERIAL ENGINEERS INC. ENGINEERING-TESTING-INSPECTIC

3025 McNaughton Drive, Columbia SC 29206, Phone (803) 788-6343

November 21, 1983

J. E. Sirrine Company, Inc.
Post Office Box 5456
216 South Pleasantburg Drive
Greenville, South Carolina 29606

Attention: Mr. Jim Brooks, P.E.
Project Manager

The Singer Company
Post Office Box 1588
Lenoir, North Carolina 28645

Attention: Mr. Richard J. McDonald

Subject: Phase II Hydrogeologic Investigation
of the Closed Landfill Area
The Singer Company, Plant No. 3
Lenoir, North Carolina
S&ME Report No. 4483-129A

Gentlemen:

Soil & Material Engineers, Inc. is pleased to submit the above referenced report. This report presents the results of field and laboratory investigations and our conclusions concerning the hydrogeology of the site.

We appreciate this opportunity to again be of service to the J. E. Sirrine Company, Inc. and the The Singer Company. If there are any questions concerning our report or study, we would be pleased to personally discuss the report and any aspects of the study at your convenience.

Respectfully submitted,

SOIL & MATERIAL ENGINEERS, INC.

Curtis L. Gorman
Project Hydrogeologist

B. C. Spigner
Senior Hydrogeologist

HYDROGEOLOGIC INVESTIGATION
OF THE
CLOSED LANDFILL AREA
THE SINGER COMPANY
PLANT NO 3

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SECTION 1.0 INTRODUCTION

1.1 PROJECT BACKGROUND AND SCOPE

In 1982 Soil & Material Engineers, Inc. (S&ME) and J. E. Sirrine Company made a preliminary (Phase I) hydrogeologic assessment of the closed landfill at Singer Furniture Plant No. 3, Lenoir, N.C. (fig.1). As part of that assessment, 4 monitor wells were constructed within and adjacent to the landfill, and the general hydrogeology of the immediate landfill site was determined.

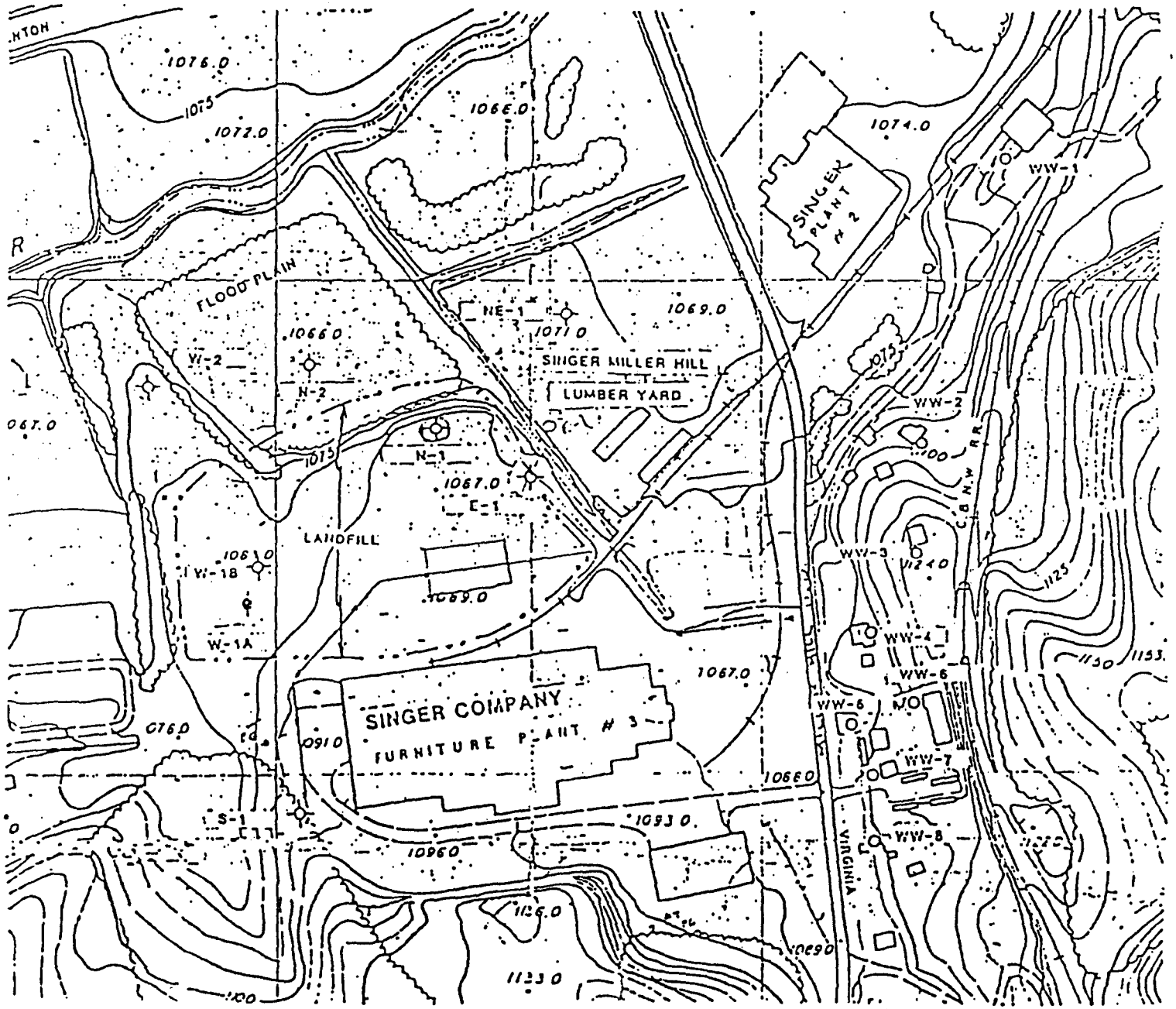
The Phase I study indicated that the Alluvial Aquifer beneath and immediately adjacent to the landfill contained higher-than-background concentrations of chemicals indicative of leachate contamination. However, the directions and rate of ground-water movement and quality of ground water in the Alluvial Aquifer down-gradient of the landfill were not known. Therefore, a Phase II study was requested by the Singer Company in order to estimate the down-gradient extent of contamination in the Alluvial Aquifer, and to evaluate the hydrologic properties of the Alluvial Aquifer down-gradient of the landfill.

The scope of work for this investigation, as outlined in S&ME Proposal No. 4483-P1163 (March 16, 1983), included constructing 3 Alluvial Aquifer monitor wells, obtaining soil samples for laboratory analysis, estimating the hydraulic properties of alluvial soils, and performing a ground-water use survey of the area surrounding the plant site. This report presents the results of our hydrogeologic assessment. For convenience, this report contains selected data obtained during the Phase I assessment.

1.2 DESCRIPTION OF THE LANDFILL AREA

The area of investigation includes the general area shown on figure 1. The principle facilities located at Singer Furniture Plant No. 3 include the closed landfill, the main plant building located immediately south of the landfill, and the lumber yard, located immediately east of the landfill. The area of investigation for Phase II was expanded to include the well survey area surrounding the plant.

The landfill was previously owned by the City of Lenoir and was used for municipal waste disposal in the late 1950's for about 3 years. The landfill was then used by the Magnavox Company until it was sold to the Singer Company in the early 1970's. Therefore, the landfill contains various waste materials which include municipal refuse, industrial wastes, and rock and soil fill. Information provided by the Plant



NOTE: BASE MAP FROM TOPOGRAPHIC MAP SUPPLIED BY SINGER CO., LENOIR, N.C.

N

LEGEND

W-1A ABANDONED TEST HOLE

WATER WELLS

MONITOR WELLS

APPROXIMATE LANDFILL BOUNDARY

SCALE IN FEET

0 200' 400'

SOIL & MATERIAL ENGINEERS
ENGINEERING · TESTING · INSPECTION
COLUMBIA, SOUTH CAROLINA

FIGURE 1. SITE MAP SHOWING MONITOR WELL LOCATIONS AND WATER WELL LOCATIONS.

4483-12

Engineer indicates that the wastes may include: toluene; acetone; methanol; various organic solvents; resin glues; and ezylene and lead from pigments. Finishing products may include lacquer, staining chemicals and paints that were probably disposed in hard form. Liquids from wash-down were previously burned, dumped or containerized until recovery operations were initiated around 1977. Scrap had been disposed in the landfill until 1981. One test hole (W-1A) was drilled and 2 monitor wells (W-1B, N-1) were installed within the landfill itself during Phase I.

The contents of the landfill were leveled during the last 4 years, and a wood shed was constructed on the landfill near the southern margin of the landfill (fig. 1). The shed is presently used primarily as a vehicle-maintainance garage.

The surface of the landfill slopes gently to the north, where it drops off abruptly near the northern margin. A thin layer of landfill material extends beyond monitor well N-1. The western edge of the landfill material extends beyond well W-1B, and northward of well W-2. The eastern perimeter of the landfill extends to the ditch adjacent to the lumber yard. The southern portion of the landfill overlies excavated fill material upon which Plant No. 3 is located.

1.3 HYDROLOGIC SETTING

Areal Geology and Hydrology

The Singer Plant No. 3 is located in the Inner Piedmont belt of the Piedmont geologic province. Rocks within the Inner Piedmont consist of Paleozoic age crystalline rocks which occur in northeast-trending belts. The plant is located in the valley of Lower Creek which flows to the southwest and empties into the upper reaches of the Catawba River.

As described by Goldsmith and others (1978), the bedrock in the vicinity of the site consists primarily of migmatite gneiss, garnet gneiss, with some biotite schist and gneiss. The bedrock is overlain by a variable thickness of residual soil called saprolite.

There are no current published reports that describe the specific hydrogeology of the area surrounding the plant. Some information on the hydrogeology of the Lenoir area was obtained from Mr. Richard Peace of the N.C. Department of Natural Resources and Community Development (DNR). According to Mr. Peace, the hydrogeology of the Lenoir area is poorly known, and there have been no recently completed ground-water studies of this area.

Land-surface elevations of the site range from approximately 1095 ft mean sea level (msl) at Plant No. 3, to 1065 ft msl in the flood plain just north of the landfill (fig. 1). The surface of the landfill slopes gently northward, and the northern edge of the landfill drops in elevation from about 1085 ft msl to about 1065 ft msl on the flood plain surface.

Surface water from the site drains toward the ditch to the northeast between the landfill and the lumber yard; and to a draw west of the site. Both these intermittent drainage features drain toward the northwest to Lower Creek. The upper portion of the site is adequately drained. The flood plain area from the landfill northward to Lower Creek is poorly drained wooded area, which is periodically flooded.

Climate

Precipitation in the Lenoir area is fairly well distributed throughout the year. The average annual rainfall for the Lenoir area is 49.94 inches. Departures from normal monthly precipitation commonly occur and mild droughts are common. The greatest precipitation generally occurs from early spring through early fall. The least precipitation generally occurs during the late fall and winter. Precipitation is the source of ground-water recharge in the area, and variations in the quantity of precipitation affect the amount of recharge to the aquifers and water levels in wells.

2.1 FIELD METHODS

Four monitor wells (N-1, E-1, W-1B, and S-1) and one abandoned test hole (W-1A) were installed during Phase I, and 3 wells (W-1, N-2, and NE-1) were installed during Phase II. The locations of these wells are shown on figure 1, and well construction information is summarized in table 1.

Split-spoon samples were collected from the test holes every 2.5 ft for the first 10 ft, where conditions while drilling in fill permitted, and at 5-ft intervals thereafter, to the total depth (TD) of each of the test holes. These samples were visually classified in the field, and later in the laboratory by the project hydrogeologist, and geologist (stratigraphic) logs were prepared (see Soil Boring and Well Records - Appendix B). These geologist logs were used in preparing geologic cross-sections of the site in order to define the subsurface stratigraphy and water-bearing character of the strata. The test holes were converted to 2-in diameter monitor wells by installing PVC casing and screen, gravel pack, bentonite annulus seal, and grout. Construction details are recorded on the boring logs in Appendix B.

Proper variances to the DNR requirements for well construction were granted by the Division of Environmental Management (DEM) prior to well construction. Field conditions required modification of the approved well construction guidelines for Phase I wells, and the well construction modifications were approved by personal communication with DEM on October 11 and 12, 1982.

The drill rig and well materials were pressure cleaned between wells to minimize potential cross-contamination. All monitor wells except well W-1B were developed with compressed air; and well W-1B was developed with water to remove sediments, drilling fluid, and contaminants which may have entered the screen/well casing during drilling and well construction.

Falling head field borehole permeability tests were made on Wells W-1B, N-1, and E-1 during Phase I in order to determine the radial permeability (hydraulic conductivity, K) of Alluvial Aquifer strata beneath the site. Falling-head tests were attempted on Phase II wells (W-2, N-2, NE-1) but permeabilities were too high to measure accurately with this method. Therefore, geologist logs and grain-size analyses of selected Alluvial Aquifer samples from wells W-2, N-2, and NE-1 were utilized to estimate the hydraulic properties of the Alluvial Aquifer at these locations.

Borehole permeability test results are summarized in table 4 and are discussed in Section 3.0.

The locations and elevations of the 7 monitor wells were surveyed by Western Carolina Surveyors with vertical control to an accuracy of about 0.01 ft. The elevations of water wells were approximated from the site topographic map and should be regarded as approximate.

Water levels were measured in the 4 Phase I monitor wells on October 13, 1982, and in all 7 monitor wells and 2 water wells on August 3, 1983. Ground-water levels were measured with an electric drop-line and fiberglass tape to an accuracy estimated to be within 0.1 ft. These water levels were then converted to approximate mean sea level (msl) elevations.

Water Well Survey:-- The project hydrogeologist conducted a water-well survey (inventory) of the area in the immediate area surrounding the plant property. Information obtained from the survey is summarized in table 2. Well-construction information was obtained from residents, neighbors, plant personnel, or others who may have had knowledge of the wells. For some wells equipped with pumps and if the owner's permission could be obtained, field analyses were made for pH, temperature, and specific conductance (Ec) on ground-water samples. If accessible, water levels and depths of wells were measured with an electric drop line and fiberglass tape. Measuring instruments were rinsed with deionized water immediately after use.

2.2 LABORATORY METHODS

Laboratory testing of soil samples collected in the field consisted of preparing geologist logs and performing 8 grain-size analyses. The geologist logs (Appendix B) were prepared by the project hydrogeologist from his own field notes, the driller's field notes, and from his lithologic description of samples in the laboratory. The grain-size analyses were made on split-spoon samples from 5 test holes (W-1B, E-1, N-2, W-2, NE-1) in order to characterize the physical properties of Alluvial Aquifer sediments beneath the site. Results of these analyses area summarized in table 3, and Appendix C, and discussed in Section 3.

3.1 GEOLOGY AND GROUND-WATER OCCURRENCE

The landfill and adjacent area is underlain by 3 geologic units that differ in physical and hydrologic properties.

Alluvial Aquifer (Unit I) -- consisting of as much as 35 ft of interbedded and (or) alternating beds of fine-coarse sand, silt, and clay; and various admixtures of these lithologies.

Saprolite and Colluvium (Unit 2) -- consisting of decomposed bedrock (saprolite) and saprolite talus (colluvium).

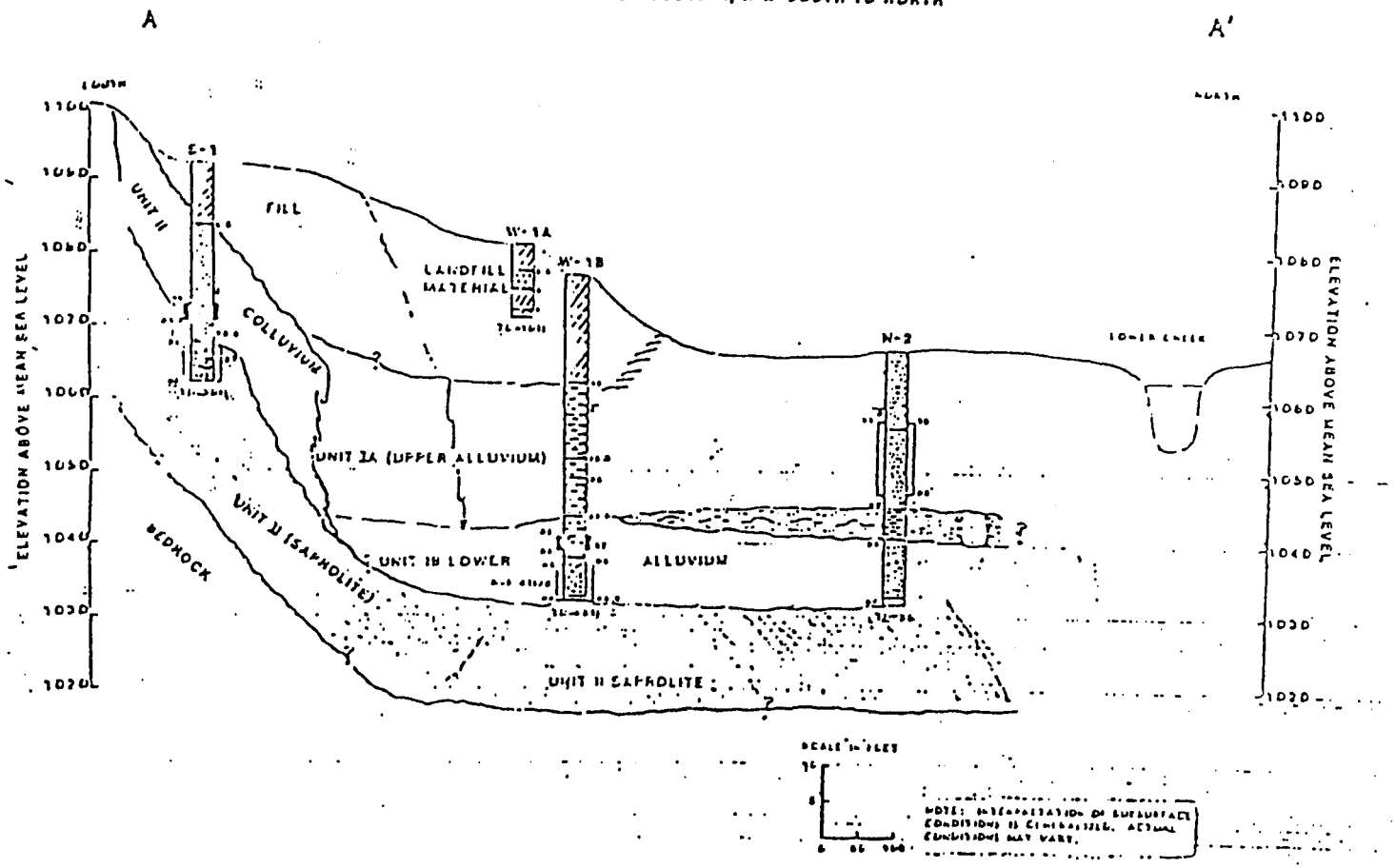
Bedrock Aquifer (Unit 3) -- crystalline (metamorphic) rocks consisting primarily of gneiss.

The stratigraphic relationships and lithology of these units beneath the plant site are illustrated in figure 2.

Initial test drilling during the Phase I study indicated that the saprolite soils contain appreciable silt and clay which are generally considered to have a much lower permeability than overlying alluvial sands. Therefore, borehole drilling depths and the emphasis of this study were limited to the alluvium and uppermost few feet of the saprolite.

Figure 2

GENERALIZED GEOLOGIC CROSS-SECTION, A-A' SOUTH TO NORTH



3.2 HYDROLOGY OF THE ALLUVIAL AQUIFER

Lithology and Thickness

The youngest geologic formation in the landfill area is the alluvium (Qal) presumably of Quaternary (Recent) age, which was deposited by Lower Creek. The alluvium is interpreted to underlie the entire landfill and the flood plain of Lower Creek.

The alluvium consists primarily of poorly sorted sediments, ranging from coarse sand and gravel to clay (see boring logs, Appendix B). The alluvium thickens from zero beneath the south part of the plant to as much as about 35 ft beneath the flood plain of Lower Creek at wells N-2 and NE-1. It is estimated to be about 30 - 35 ft thick beneath the landfill (fig.2). Most of the alluvium consists of water-bearing sands, and is herein referred to as the Alluvial Aquifer.

On the basis of lithology and texture, the alluvium can be divided into an upper unit (Unit 1A) and a lower unit (Unit 1B). The upper unit (Unit 1A) consists primarily of alternating and interbedded thin beds of very fine to fine clayey sand; silty sand; sandy clay; sandy, silty clay; and clayey silt. Although thin beds of moderately sorted sands occur in this unit, the sediments are mainly poorly sorted and the percentage of fines (silt and clay) is estimated to be more than 25 percent in most samples. The percentage of fines in 2 upper unit soil samples is 79.1 percent and 97 percent (table 3).

The lower unit contains coarser-grained and better sorted sediments than those in the upper unit. Unit 1B consists predominantly of medium to coarse sand with various admixtures of very-fine to fine sand. Thin gravel lenses occur near the base of the lower alluvium. Thin (2-4 ft thick) clays occur in the lower unit that may or may not be continuous between monitor wells. The more permeable sands of this unit contain less than 15 percent fines (table 3).

Hydrologic Properties

The hydrologic properties of the Alluvial Aquifer were determined on the basis of geologist (lithologic) logs of the test borings, borehole permeability tests on 3 wells (table 4), grain-size analyses on selected samples (table 3) and water-level measurements in the 7 monitor wells and 2 water wells (table 5).

The hydrologic properties of the Alluvial Aquifer are governed primarily by the lithology and texture of sediments. Because of this variable texture, there is a wide variation in water-bearing characteristics of the

TABLE 3. SUMMARY OF PHYSICAL LABORATORY TESTS
SINGER - LENOIR

Well No.	Depth of Sample (ft)	Sample Description	Hydrogeologic Unit	% Silt and Clay (0.074 mm)	Estimated[1] Effective Porosity n_e
W-1B	28.5 - 30	Slightly Sandy CLAY	Unit 1A	79.1	5 - 10%
E-1	18.5 - 20	Silty SAND	Unit 1B	22.0	20%
NE-1	13.5 - 15	Slightly sandy, silty CLAY	Unit 1A	97.0	5%
NE-1	23.5 - 25	Fine to Coarse SAND	Unit 1B	6.0	30%
N-2	23.5 - 25	Silty, Sandy CLAY	Unit 1B	88.0	5 - 10%
N-2	28.5 - 30	Fine to Coarse SAND	Unit 1B	7.0	30%
W-2	23.5 - 25	Clayey SAND	Unit 1B	12.0	25%
W-2	33.5 - 35	Clayey SAND	Unit 1B	6.0	30%

NOTE: Effective porosity estimates of granular sediments (sands) based on method described in Johnson (1967), U.S. Geol. Survey Water-Supply Paper 1662-D. Effective porosity estimates of silty clays and clays based on general estimates of porosity and permeability values of similar sediments compile[illegible]ring other investigations by Soil & Material Engineers, Inc.

TABLE 4. SUMMARY OF FIELD BOREHOLE PERMEABILITY TESTS
SINGER - LENOIR

WELL NO.	DEPTH OF SCREEN INTERVAL TESTED (ft)	ESTIMATED RADIAL HYDRAULIC CONDUCTIVITY (cm/sec)	(ft/day)	HYDROGEOLOGIC UNIT	LITHOLOGY	REMARKS
W-1B	40 - 45	3.3×10^{-4}	9.4	Unit 1B	Slightly Silty SAND	
E-1	27 - 32	8.6×10^{-3}	24.4	Unit 1B	Slightly Silty, Medium to Coarse SAND	
N-1	9.7 - 19.7	7.0×10^{-5}	0.2	Unit 1A/Unit 1B	Silt, and Fine to Coarse SAND	Well Screen not fully developed, therefore calculated permeability is considered lower than actual permeability.

Note: Falling head tests performed October 13, 1982

S&ME Job No. 4482-129A

Alluvial Aquifer. The upper unit (1A), which contains poorly sorted, fine sediments is less permeable than the lower unit (1B).

Ground water in the Alluvial Aquifer occurs primarily under water-table (unconfined) conditions, although clays locally cause semi-artesian conditions. Hydraulically, the Alluvial Aquifer is an anisotropic unconfined aquifer. Radial permeabilities (hydraulic conductivity, K) of the more permeable sands are estimated to be in the 25-50 ft/day range; with less permeable, poorly-sorted fine sands having estimated permeabilities in the 1-5 ft/day range.

The porosities (n) of sediments within the Alluvial Aquifer are estimated to be within the range of 20 percent (sands) to about 50 percent (clays). However, the effective porosity (n_e), the percentage of connected pores, governs ground-water movement through saturated sand aquifers. The effective porosity of a granular unconfined aquifer is considered, for practical purposes, to be approximately equal to the specific yield (Sy) of that aquifer. Effective porosities of the well sorted sands in the lower unit are estimated to range from 20 percent to 30 percent; and the effective porosities of the lower permeability clays are estimated to be in the 5-10 percent range (table 3).

Recharge and Lateral Ground-Water Movement

A water-table (potentiometric) map of the Alluvial Aquifer was constructed from water-level measurements made on August 3, 1983 in the 7 monitor wells and 2 water wells located east of the site (fig.3). Water-level elevations in the on-site monitor wells were determined from surveyed top of casing (TOC) measuring points. Water-level elevations in the water wells are based on measuring point elevations estimated from the topographic map, and should be considered approximate.

Interpretation of the water-table map indicates the following:

- The Alluvial Aquifer is recharged in areas southeast of the landfill, and ground water moves from southeast to northwest.

- Hydraulic gradients (dh/dL) along selected ground water flowlines through the landfill area average about 0.01 ft/ft.

- Ground water moving through the Alluvial Aquifer discharges into the Lower Creek flood plain, which is interpreted to be the local discharge area for the Alluvial Aquifer.

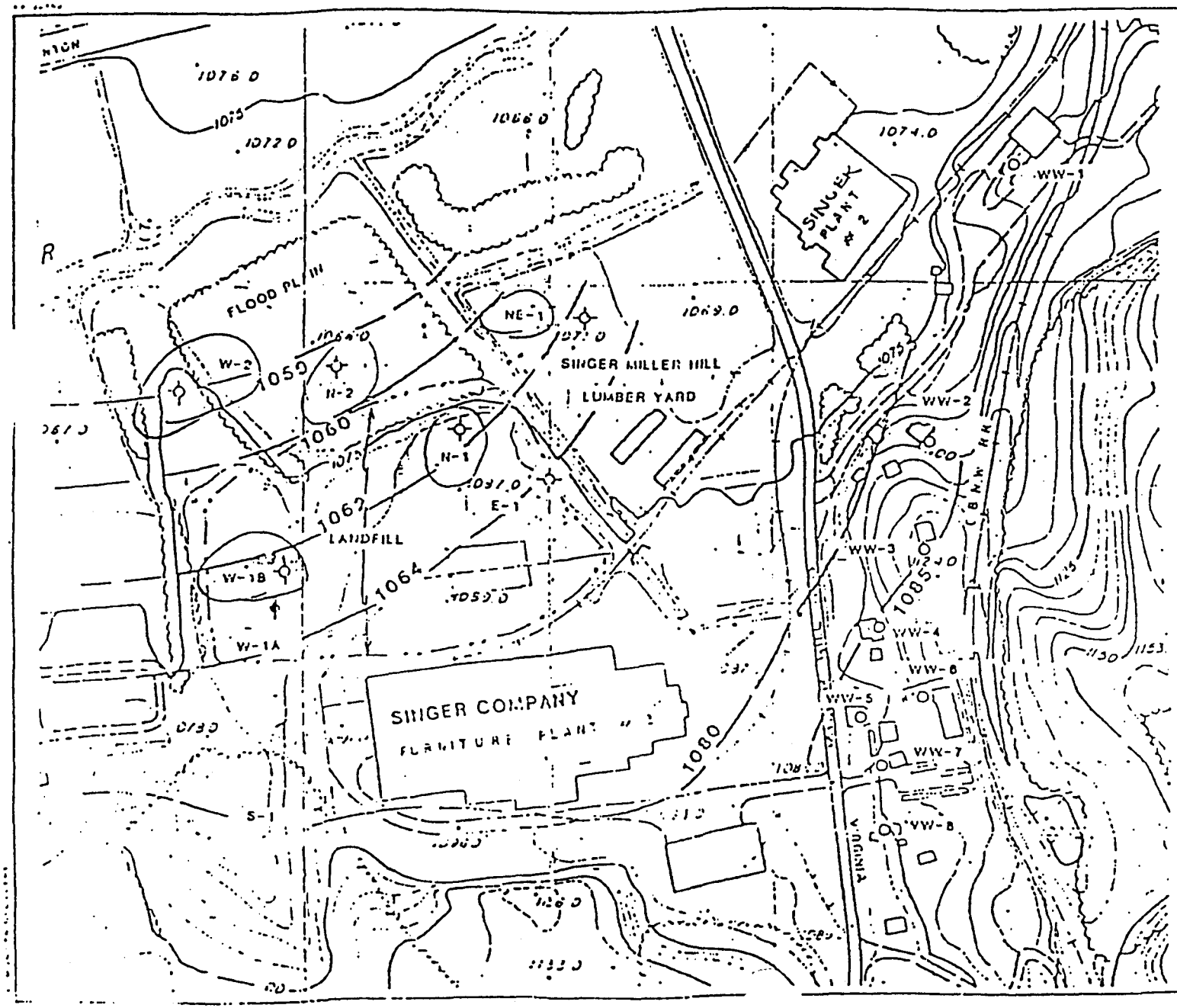


FIGURE 3. POTENTIOMETRIC MAP OF THE ALLUVIAL AQUIFER, AUGUST 3, 1983.

TABLE 5. SUMMARY OF WATER LEVEL DATA, SINGER-LENOIR.

WELL NO.	ELEV. M.P.	DATE MEASURED	WATER LEVEL BELOW M.P.	WATER LEVEL ELEV.	MEASURED BY	REMARKS
W-1B	1082.65	10/13/83 8/3/83	20.5 20.3	1062.15 1062.35	C. Gorman	Well screened in Unit IB
N-1	1072.59	10/13/82 8/3/83	10.4 10.65	1062.19 1061.94	C. Gorman	Well screened in Unit IA/IB
E-1	1073.82	10/13/83 8/3/83	9.9 9.3	1063.92 1064.52	C. Gorman	Well screened in Unit IB
S-1	1098.32	10/14/82 8/3/83	20.2 18.5	1078.12 1079.82	Chris Silkwood C. Gorman	Well screened in Unit II (saprolite)
N-2	1069.84	8/3/83	10.6	1059.24	C. Gorman	Well screened in Unit 1A
W-2	1072.47	8/3/83	13.5	1058.97	C. Gorman	Well screened in Unit 1B
NE-1	1070.65	8/3/83	8.2	1062.45	C. Gorman	Well screened in Unit 1B
WW-2	±1100	8/3/83	19.0	±1081	C. Gorman	Shallow (22 ft) dug well; may tap saprolite (Unit II)
WW-3	±1124	8/3/83	39.0	±1085	C. Gorman	Shallow (42ft) dug well; may tap saprolite (Unit II)

NOTE: Measuring Point (MP) of all wells is top of casing (TOC).

The rate of ground-water movement through the Alluvial Aquifer is assumed to be laminar and governed by Darcy's equation for laminar flow:

$$v = \frac{K}{n_e} \cdot dh/dL$$

where, v = average linear ground-water velocity (in ft/day);
K = radial hydraulic conductivity (in ft/day);
n_e = effective porosity (decimal fraction); and
dh/dL = hydraulic gradient.

Substitution of average estimated values of K= 0.1 ft/day to 50 ft/day, n_e= 0.05 to 0.30, and an average dh/dL= 0.01 ft/ft yields average linear ground-water velocities of 0.02 ft/day (7 ft/yr) to 1.7 ft/day (610 ft/yr) for ground water moving laterally through the Alluvial Aquifer. The higher ground-water flow velocities would occur in the more permeable sands within the lower alluvium (Unit 1B).

Vertical Ground-Water Movement

The vertical movement of ground water in the Alluvial Aquifer is governed by the same hydraulic principles that govern lateral ground-water movement. However, in horizontally bedded alluvial sediments, the vertical permeability (K') is often orders of magnitude lower than radial permeability. There are no laterally continuous, low-permeability confining beds separating the upper unit (1A) and lower unit (1B). Therefore, ground water moves slowly downward from the upper unit into the lower unit.

The Alluvial Aquifer is separated from the Bedrock Aquifer by an unknown thickness of low-permeability silts and clays (saprolite) which was penetrated at wells S-1 (23.5-30 ft), N-2 (34.5-35.0 ft), and NE-1 (34-35 ft). This low permeability saprolite functions as a confining bed which restricts the downward vertical movement of ground water from the Alluvial Aquifer into the Bedrock Aquifer.

Utilization

The area in the vicinity of the Singer Plant is served by public water and sewer by the City of Lenoir. A public water distribution line is located along Virginia Street east of the plant. Some residents east of Virginia Street utilize public water and some utilize wells for drinking-water and other domestic (household) uses.

A well survey was made in the area immediately adjacent to the landfill. The only wells found in close proximity to the landfill area are located east of Virginia Street

(fig.1) and are hydraulically up-gradient of the landfill area. Information obtained from the well survey is summarized in table 2.

Information obtained from the survey indicates that 2 shallow dug wells (WW-2, WW-3) are used for drinking-water supplies and other domestic uses. Two other shallow dug wells (WW-6, WW-7) are used for domestic irrigation, showers, and other domestic uses but not for drinking water. Three wells (WW-4, WW-5, and WW-8) are currently unused, and the residents obtain water from the City of Lenoir public water system.

As shown on table 2, most residents do not recollect particular details regarding well construction. The depths of 2 dug wells (WW-2, WW-3) were measured and are shallow wells (22 ft, 42 ft). The depths of 3 other large-diameter dug wells were reported as 17-22 ft, which are probably reasonably accurate. These wells are located at elevations above about 1095 ft msl and are above the flood plain. Therefore, they probably tap saprolite soils rather than the Alluvial Aquifer.

There are no water wells that tap the Alluvial Aquifer located on Singer property or in the area down-gradient between the landfill and Lower Creek.

3.3 BEDROCK AQUIFER

Distribution and Lithology

Crystalline bedrock underlies the landfill area and immediate vicinity of the landfill and the flood plain of Lower Creek. The Bedrock Aquifer and Alluvial Aquifer are separated by an unknown thickness of saprolite, which is weathered, decomposed bedrock.

The background well (S-1) and 3 monitor wells near the landfill (E-1, N-2, and NE-1) penetrated into the top of saprolite. The depths of these monitor wells were purposely terminated after drilling 1-2 ft into the saprolite; therefore the thickness of saprolite that overlies bedrock is not known.

Samples of saprolite from these wells are composed of quartz, weathered feldspars, dark minerals (probably hornblende or augite), and mica. The texture is primarily silt and silty clay, which is typical of a weathered biotite-hornblende gneiss. Typically in the Piedmont, there is a gradual change from the highly weathered saprolite to the underlying less weathered bedrock.

Crystalline bedrock of the landfill area has been mapped as migmatite gneiss, garnet gneiss, hornblende gneiss, and schist (Goldsmith and others, 1978). The lithology of saprolite form boring samples indicates that the bedrock is probably biotite-hornblende gneiss.

Ground-Water Occurrence and Hydrologic Properties

According to Mr. Richard Peace of the NCDNR, the hydrogeology of bedrock aquifers in the Lenoir area is poorly known. In general, the occurrence, movement, and availability of ground water in the Bedrock Aquifer is probably typical of other crystalline-rock areas where the hydrogeology is known.

Typically, the saprolitic soils overlying bedrock are porous but generally have low permeability and effective porosity. In some areas the saprolite functions as a storage reservoir that slowly recharges fractures in the underlying bedrock; in other areas, the saprolite functions more as a low permeability confining bed over the bedrock aquifer.

In some areas, the saprolite is sufficiently permeable to supply small quantities of ground water to dug and bored wells. The 7 large-diameter dug wells east of Virginia Street probably tap the saprolite.

Ground water in the Bedrock Aquifer occurs within and along water-bearing fractures developed from the weathering along

joints and other planes of weakness. Fractures in the Bedrock Aquifer beneath the landfill area are probably recharged by infiltration of rainfall into and through the saprolite and weathered bedrock in the topographically high areas immediately south and southeast of the plant site. Presumably ground-water movement through the Bedrock Aquifer is northward and northwestward toward the Lower Creek valley. Because the Bedrock Aquifer recharge areas are at comparatively high elevations (1100-1200 ft msl), ground water in the Bedrock Aquifer beneath the landfill area probably exists under considerable artesian pressure.

Apparently, the only utilization of the Bedrock Aquifer in the immediate area of the site is from one well (WW-1) at Southeastern Adhesives Co., located about 1100 ft northeast of the landfill. This 6-inch diameter well, reportedly 300 ft deep, is reportedly pumped at about 3000-4000 gpd (2-4 gpm).

SECTION 5.0 SELECTED REFERENCES

Goldsmith, R., Milton, D. F., and Wilson, F.A., 1978, Preliminary Geologic Map, Geologic Map Index, and Annotated Bibliography, Charlotte 2 Degree Sheet, North Carolina and South Carolina: Open-File Rept. No. 78-590, U.S. Geol. Survey, Reston, Virginia.

Johnson, A.I., 1967, Specific Yield of Granular Sediments: U.S. Geol. Survey Water-Supply Paper 1662-D.

STATE North Carolina

COUNTY Caldwell

TABLE 1. SUMMARY OF WELL CONSTRUCTION DATA SINGER-LENOIR.

SOIL & MATERIAL ENGINEERS WELL SUMMARY

SME JOB NO. 8882-129

Well No.	State Number	SEME Well No.	Elevation (MSL)	Owner/Location	Well Use	Total Depth	Casing Dia.	Casing Depth	Pump Rate	Date Comp.	Logs	Chemical Analyses	Well Const.	Remarks
TH-1A			1081	West of Landfill	ABN	10	None			10/12/82	Drillers			Test hole abandoned because of garbage and debris.
W-1B			1079.89	West of Landfill	OBS	45	2-in. PVC	40 ft.		10/12/82	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 40-45 ft, set in slightly silty, medium sand to small gravel. Perm. test. Grain size 28.5-30.
N-1			1069.26	North of Landfill	OBS	21.5	2-in. PVC	9.7 ft.		10/12/82	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 9.7-19.7 ft, set in fine to coarse sand, slightly silty to silty. Perm. test.
E-1			1070.37	East of Landfill	OBS	35	2-in. PVC	27 ft.		10/13/82	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 27-37 ft, set in medium to coarse sand. Perm. test. Grain size 18.5-20.
S-1			1095.50	South of Landfill by Main Plant Bldg.	OBS	30	2-in. PVC	25 ft.		10/18/82	Drillers	Inorganic Pesticide Volatile	GP	Screen 25-30 ft, set in saprolite. Background observation well.
W-2	J87-g6		1071.02	200 ft. NW of Landfill	OBS	35	2-in. PVC	23 ft.		5/2/83	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 23 28 ft. Grain size 23.5-25; 33.5-35.
N-2	J87-g7		1066.95	100 ft. N of Landfill	OBS	35	2-in. PVC	10 ft.		5/2/83	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 10-20 ft. Penetrate saprolite at 34.5 ft. Grain size 23.5-25; 28.5-30.
NE-1	J87-g5		1067.88	200 ft. NE of Landfill in Lumber Yard	OBS	35	2-in. PVC	25.3 ft.		5/3/83	Drillers Geologists	Inorganic Pesticide Volatile	GP	Screen 25.3-30.3 ft. Penetrate Saprolite at 34 ft. Grain-size 13.5-15; 23.5-25.

SEME HD-1 (rev. 11/82)

SEME Job 8882-129A

STATE N.C.

COUNTY Caldwell

SOIL & MATERIAL ENGINEERS WELL SUMMARY

TABLE 2. SUMMARY OF DATA ON WATER WELLS NEAR SINGER-LENOIR PLANT.

SAME JOB NO. 8483-129A

Well No.	State Number	SAME Well No.	Elevation (MSL)	Owner/Location	Well Use	Total Depth	Casing Dia.	Casing Depth	Pump Rate	Date Comp.	Logs	Chemical Analyses	Well Cons.	Remarks
WW-1			±1090	Southeastern Adhesives Co.	IND	Rept. 300	6-in.	NA	23	Rept. c.1979				Driller Setzer, Hickory. Process water ±3000 - 4000 gpd. Ec=175; pH-6.5.
WW-2			±1098	B. Greer 815 B Virginia St.	Dom.	Rept. 60 ft. meas. 22 ft.	60 dug			c. 1930's				Dug well, approx. 5 ft. diam. No pump. Sole water supply; also supplies water next door. Static level 19 ft; Ec=110, pH=5.8.
WW-3			±1122	Gynum Blankenship 823A Virginia St.	Dom.	Rept. 65 ft. meas. 42	48 dug			c.1911				Dug well, approx. 4 ft. diam. 1 1/2 hp. pump. Sole supply for two apt's. Static level=39 ft. Ec=100, pH=5.9.
WW-4			±1104	Martin 827 Virginia St.	Unu.									Well is available for use but resident uses city water. Well not used. Located on back porch.
WW-5			±1095	Mr. Sudders 831 Virginia St.	Unu.	Rept. 19 ft	24 dug			c. 1960's				Dug well, 24-in. (?). Well is available for use but resident uses city water.
WW-6			±1102	Mr. Sudders 831 Virginia St.	Irr	Rept. 22 ft.	24 dug			c.1978				Dug well, 24-in. 1 1/2 hp. pump. Used for household irrigation. Not used for drinking.
WW-7			±1102	Matty West 871 Virginia St.	Dom.	Rept. 17 ft.	24 dug							Dug well, 24-in. Resident obtains water from neighbors, for drinking. Well used for showers, etc. Supplies house & 4 mobile homes.
WW-8			±1095	A.G. Jenkins 913 Virginia St.	Unu.									Well construction unknown. Well in back of house. Owner reptd. unused. Well probably a dug well.

SAME HD-3 (rev. 11/82)

SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

Location: The Singer Co-Lenoir County: Caldwell, N.C. Job No.: 4482-129 Boring or Well No.: S-1

Logged by: C. Silkwood Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: ____

Date Started: 10/13/82 Boring Depth: 30 ft Static Water Level: 20.2 ft

Date Completed: 10/14/82 Well Depth: 30 ft Permeability Tests: none

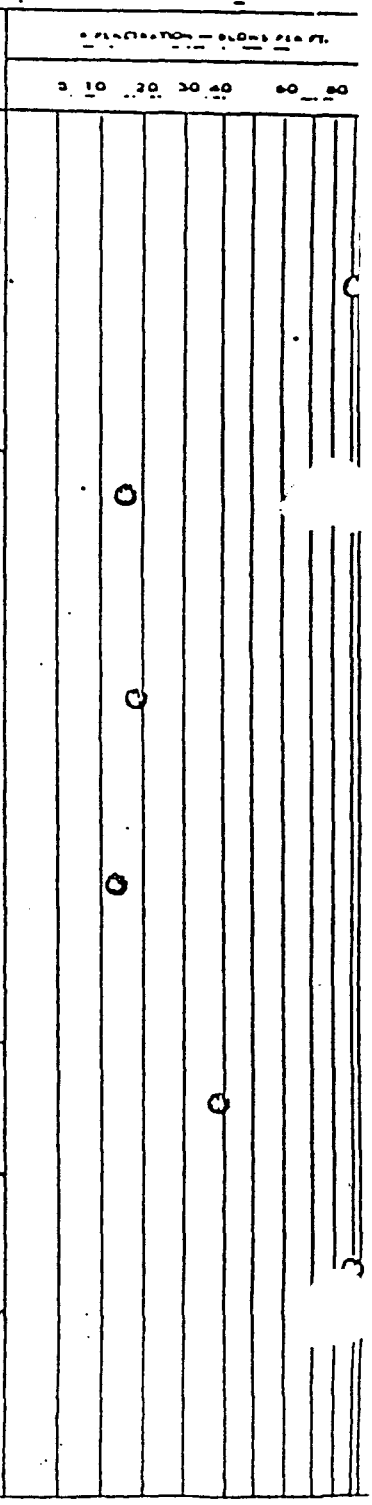
Drilling Method: Auger Casing: 2-in PVC, Sch 80 Thrd, 0-25 ft

Development Method: Flushed 140 gal. water Screen: 2-in PVC, Sch 80, Thrd, .025-in slot, 25-30 ft Seal: Bentonite 19

Soil Samples: Split Spoon Grout: Portland 0-19 ft.

Geophysical Logs: none Chem. Analysis: Inorganic & Organic

Elev.	Depth Ft.	TOC= LS= Description
		Silt, red/brown, loose-to-firm, slightly clayey, with fine to medium grained, quartzose sand, some muscovite flakes and weathered feldspar fragments, some organic material. Fill.
SS		Silt, as above
	8.5	
SS		Sand, orange/white, firm, with very fine to coarse grained quartz and feldspar fragments, silty, some biotite and muscovite, highly weathered.
SS		Sand, as above, yellow/brown, large feldspar fragments, silty.
SS		Sand, red/brown, firm, with very fine to coarse grained quartz and feldspar grains, large feldspar fragments not as numerous, heavily muscovitic, moist, highly weathered.
SS	23.5	Saprolite, red/brown, white, mottled, quartzose and feldspathic grains and fragments, feldspars are soft, heavily weathered, dark minerals-augite, in fragments, very silty, very fine rock fragments.
	27.0	Saprolite, white to brown, quartzose and feldspathic grains and fragments, feldspars firmer, abundant muscovite, sand grains predominantly coarse, biotite flakes - very fine, heavily weathered.
SS	30.0	
		Boring terminated at 30 ft.
		SS = Split-Spoon Sample



SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-1A (T

Logged by: C. Gorman Drilled by C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 10 ft Static Water Level: None

Date Completed: 10/12/82 Well Depth: Abandoned Permeability Tests: None

Drilling Method: Auger Casing: None

Development Method: None Screen: None Seal: None

Soil Samples: Split Spoon Grout: None

Geophysical Logs: None Chem. Analysis: None

Elev.	Depth Ft.	TOC= LS= Description
		Silt, red/brown, finely to medium sandy, quartzose, some muscovite flakes.
SS	3.5	Garbage, wood debris, cans.
SS	6.0	Sand, red/brown, very fine-to-coarse grained, subangular, very silty, gneissic composition.
SS	9.0	Debris hindering drilling - 9.3 ft.
	10.0	Abandoned test hole at 10 ft. due to garbage and debris.

SS = Split-Spoon Sample

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-18(

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 45 ft. Static Water Level: 20.5 ft

Date Completed: 10/12/82 Well Depth: 45 ft. Permeability Tests: Falling Head

Drilling Method: Auger Casing: 2-in. PVC Sch 80 Thrd. 0-40 ft.

Development Method: Flushed 100 gal. water Screen: 2-in PVC Sch 80 Thrd. .025-in. slot 40-45 ft. Seal: Bentonite, 36-38 ft.

Soil Samples: Split Spoon Grout: Portland, 0-36 ft.

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

Elev.	Depth Ft.	TOC= LS= Description	Penetration Resistance (Blows per ft.) 5 10 20 30 40 60 80
		Fill, silt, wood debris, charcoal, glass.	
SS			
		Fill, as above.	
		Water table at approximately 13 ft in borehole.	
	15.0		
SS		Clay, grey, firm, sticky, silty, some muscovite flakes, with large amounts of imbedded medium-to-coarse grained, subangular sand.	
		Clay, medium brown, grey, mottled, soft-to-firm, sticky, slightly silty, with some muscovite flakes, sand content very low, medium- to-coarse grained, very faint oil odor.	
SS			
		Clay, as above, plastic, no odor; grading to	
SS			
	25.5	Silt, blue/grey, very clayey, plastic and sticky, with very small amounts of fine grained sand. Very loose, muscovitic, sand content increasing at 28 ft.	
	28.0		
SS			
	33.0	Sand blue/grey, very fine, some coarse grained, subrounded to subangular, moderately sorted, very silty, slightly clayey, muscovite.	
SS			

SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-1B(

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 45 ft. Static Water Level: 20.5 ft

Date Completed: 10/12/82 Well Depth: 45 ft. Permeability Tests: Falling Head

Drilling Method: Auger Casing: 2-in. PVC Sch 80 Thrd. 0-40 ft.

Development Method: Flushed 100 gal. water Screen: 2-in PVC Sch 80 Thrd. .025-in. slot 40-45 ft. Seal: Bentonite, 36-38 ft.

Soil Samples: Split Spoon Grout: Portland, 0-36 ft.

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

	Elev.	Depth Ft.	TOC= LS= Description	Penetration Resistance Blows per Ft. 5 10 20 30 40 60 80
		37.0	Silt, grey, with some fine grained sand.	
	SS	39.0	Sand, light yellow/brown, to red/brown from staining, very fine to coarse, predominantly medium grained, subangular, poorly sorted, very slightly silty, muscovite and biotite flakes-fine, some orange oxide stains; grading to medium-to-coarse grained sand at 43.5 ft; large gravelly layer, subangular to rounded at 44.5 ft, imbedded with medium-to-coarse grained sand, muscovite and biotite flakes present.	
	SS	43.5		
		44.5		
		45.0		

Boring terminated at 45 ft.

SS = Split-Spoon Sample

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

The Singer Co.

Location: Lenoir County Caldwell, NC Job No.: 4482-129A Boring or Well No. E-1(

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/13/82 Boring Depth: 35 ft Static Water Level: 9.9 ft

Date Completed: 10/13/82 Well Depth: 32 ft Permeability Tests: Falling Head

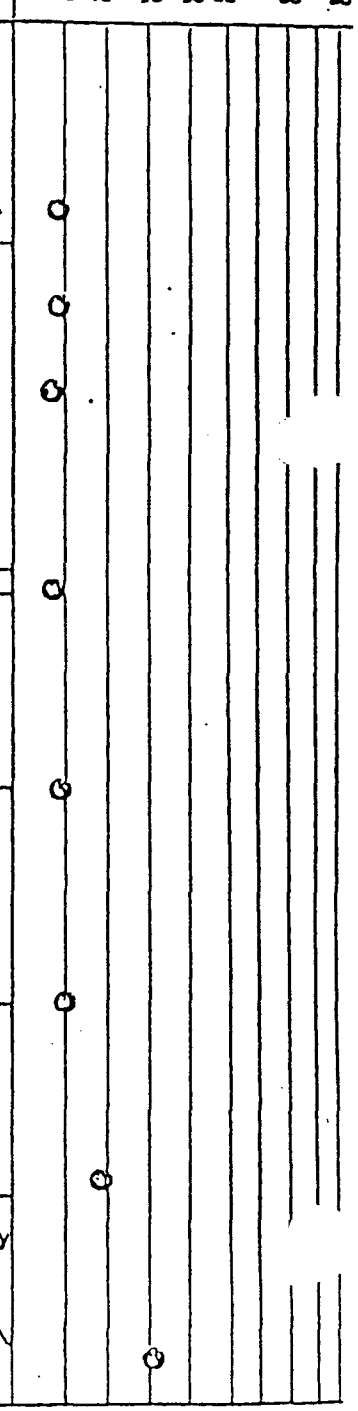
Drilling Method: Auger Casing: 2-in PVC Sch 80 Thrd, 0-27 ft

Development Method: Compressor Air Screen: 2-in PVC Sch 80 Thrd, .025-in slot, 27-32 ft Seal: Bentonite 23-25 ft

Soil Sampled: Split-Spoon Grout: Portland, 0-23 ft

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

Elev.	Depth Ft.	TOC= LS= Description
		Fill, silt, rock fragments, muscovite flakes, debris.
SS	5.5	
SS		Clay, dark grey, soft-firm, sticky-plastic, slightly silty, with some fine grained imbedded sand, muscovite flakes present.
SS		Clay, blue/grey, soft, sticky-plastic, slightly silty, with some imbedded medium-to-coarse grained sand, quartzose, abundant muscovite flakes.
SS	13.5	Silt, blue/grey, soft, very clayey, with some imbedded medium-to-coarse grained sand, quartzose, abundant muscovite flakes.
SS	19.0	Sand, grey, very fine-t-fine grained, some medium grained, subangular, very silty, clayey, poorly sorted, abundant muscovite flakes; interbedded with small silt layers containing very fine sand.
SS	24.5	Sand, grey, loose, very fine-to-fine grained, some medium grained, subrounded to subangular, slightly silty, slightly clayey, moderately sorted, muscovite flakes present.
SS	29.5	Sand, light yellow, with some orange/brown staining, medium-to-coarse grained, subangular, very slightly silty, moderately sorted, muscovite-biotite in fine particals, some oxide staining.
SS	33.5	Sand, fine grained to large gravel, yellow/brown, slightly silty, very poorly sorted, abundant gold muscovite flakes, biotite, quartz and feldspar fragments.
	35.0	Boring terminated at 35 ft.



SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: The Singer Co.-Lenoir County: Caldwell, N.C. Job No.: 4482-129 Boring or Well No.: N-

Logged by: C. Corman Drilled by: C. Silkwood Grid Coord.: 21.5 ft. Lat.-Long.:

Date Started: 10/11/82 Boring Depth: 21.5 ft Static Water Level: 10.4 ft

Date Completed: 10/12/82 Well Depth: 19.7 ft. Permeability Tests: Falling Hea

Drilling Method: Auger Casing: 2-in PVC, Sch 80 Thrd, 0-9.7 ft.

Development Method: Flushed 100 gal. water Screen: 2-inch PVC Sch 80 Thrd, .025-in slot 9.7 - 19.7 SEAL: Bentonite 6.

Soil Samples: Split Spoon Grout: Portland 0-6.5 ft.

Geophysical Logs: none Chem. Analysis: Inorganic & Organic

Elev.	Depth Ft.	TOC= LS= Description	
		Silt, red/brown, with very fine grain, some coarse grained, quartzose, subangular sand, strong propellant odor.	
	3.5	Silt, light red/brown, with very fine grain, some coarse grained, quartzose, subangular sand, clayey, micaceous, feldspar grains, strong propellant odor, rags and debris from 4.5 to 5.0 ft.	
SS	4.5	Clay, grey/black, firm, sticky, with some imbedded very fine-to-fine, some coarse grained sand, very fine muscovite flakes, some organic material and rag fibers.	
SS	5.0		
	8.0	Sand, grey/black, loose, very fine-to-medium grained, slightly silty, predominately quartzose, some feldspathic grains, subrounded to subangular, moderately sorted, abundant muscovite, no odor, wet.	
SS			
	12.0	Silt, grey, with fine-grained sand, grading to silty sand.	
SS	14.0	Sand, grey, fine-to-very coarse grained, firm, predominantly quartzose, some feldspathic grains, subrounded to subangular, poorly sorted, some muscovite flakes, larger grains are angular.	
SS			
	20.0	Grading to brownish-grey silty sand at 20 ft.	
	21.5	Boring terminated at 21.5 ft.	

SS = Split-Spoon Sample

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: Singer Co. Plant#3 County: Caldwell, NC Job No.: 4483-129A Boring or Well No.: N-

Logged by: C.Gorman Drilled by: H.Howard Grid Coord.: J74-g7 Lat.-Long.:

Date Started: 8/2/83 Boring Depth: 35 ft. Static Water Level: 7.3 ft.

Date Completed: 8/2/83 Well Depth: 21.2 Permeability Tests: Falling Head

Drilling Method: Mud Rotary Casing: 2-in PVC Schd 40, flush thd 0-10 ft.

Development Method: Screen: 2-in PVC Sch 40 thd, 0.015-in slots, 10-20 ft. Seal: Bent. 6-8

Soil Samples: Split-spoon Grout: Portland cem. 0-6 ft.

Geophysical Logs: Chem. Analysis:

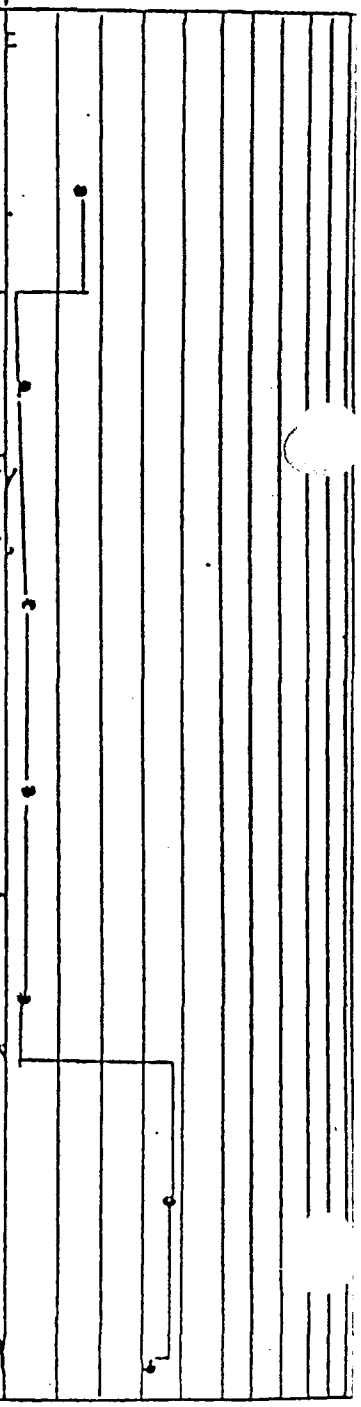
PENETRATION IS THE NUMBER OF BLOWS OF 140 LB WT FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER

DISTURBED SAMPLE — WATER TABLE

UNDISTURBED SAMPLE — WATER TABLE

TOC=1069.84
LS=1066.95

±1064 Elev.	Depth	Description
		Brown SAND, fine to very fine, loose; with abundant SILT and muscovite, with rooted organics.
	7	Dark Gray, SAND, fine to very fine, loose; with some SILT and abundant muscovite, some organics. Water table at about 8 ft. in borehole.
	11	Interbedded dark gray SAND, fine to very fine, very loose with SILT and abundant muscovite; and light gray SAND, medium to coarse, angular to subangular, very loose, mostly quartzose with some feldspar; some decomposing wood fragments. Severe caving at 18.5-20 ft. Pulled auger and switched to mud rotary drilling.
	22	Grades to underlying Dark gray CLAY, very soft, plastic; with small amounts of very fine SAND, abundant muscovite and some wood fragments.
G.S.	26	Gray SAND, very fine to mostly medium to coarse SAND, subrounded to angular, with some gravel to 1-in, subangular to subrounded, very firm; with abundant muscovite and dark minerals. Hard drilling from 26 - 31 ft.
G.S.	34	Mottled white and black SAPROLITE, very fine to medium grained, very firm, consisting of quartz, feldspar, amphibole and muscovite.



Boring Terminated @ 35 ft.

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: Singer Co. Plant #3 Lenior County: Caldwell, NC Job No.: 4483-129A Boring or Well No.: NE-1

Logged by: C. Gorman Drilled by: H.Howard Grid Coord.: J74-g8 Lat.-Long.:

Date Started: 8/3/83 Boring Depth: 35 ft. Static Water Level: 5.5 ft.

Date Completed: 8/3/83 Well Depth: 30.3 ft. Permeability Tests:

Drilling Method: Power Auger Casing: 2-in. PVC Sch 40, flush thd., 0-25.3 ft.

Development Method: Screen: 2-in PVC Sch 40 thd., ~~0-0.15-in slots, 25.5-30.5 ft~~ Seal: Bent., 19-

Soil Samples: Split-spoon Grout: Portland cem. 0-19 ft.

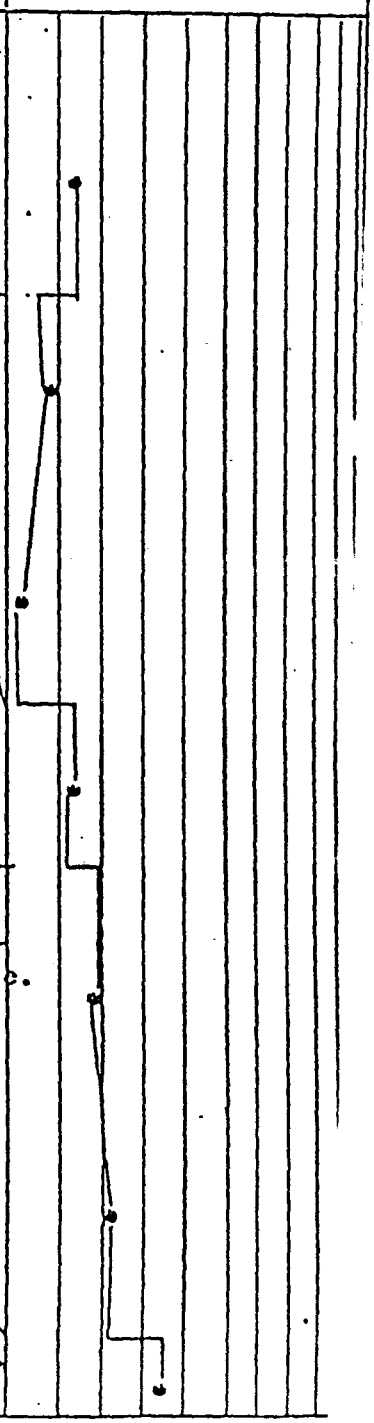
Geophysical Logs: Chem. Analysis:

PENETRATION = THE NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 IN REQUIRED TO DRIVE 1.4 IN I.D. SAMPLER

MS SAMPLE — WATER TABLE

UNDISTURBED SAMPLE — WATER LEVEL

	Elev.	Depth	TOC=1070.65 LS=1067.88 Description
			Brown SAND, very fine to fine, loose; with some SILT and muscovite, some rooted organics.
		7	Gray CLAY, soft; with very fine to fine SAND, and abundant muscovite, with some organics.
	G.S		
		17	Gray SAND, very fine to medium, loose, subangular; with slight SILT content, and abundant muscovite, and dark minerals. Water Table was encountered at about 17 ft. and rose up auger hole.
		21	Dark gray SILT and CLAY, very soft; with very fine SAND and abundant muscovite.
	G.S	23	Brown to gray SAND, fine to mostly medium to coarse, loose, quartzose subangular; with some gravel at 29 ft., with some mica and dark minerals.
		34	Mottled white and brown SAPROLITE, very fine to medium grained, very firm, consisting of quartz, feldspar, amphibole and muscovite.



Boring Terminated 0 35 ft.

SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

cation: Singer Co. Plant#3 Lenoir, N.C. County: Caldwell Job No.: 4483-129A Boring or Well No.: W-2

gged by: C. Gorman Drilled by: H. Howard Grid Coord.: J74-g6 Lat.-Long.:

te Started: 8/2/83 Boring Depth: 35 ft. Static Water Level: 10.2 ft.

te Completed: 8/2/83 Well Depth: 28 ft. Permeability Tests:

rilling Method: Power Auger Casing: 2-in PVC, Sch 40, flush thd, 0-28 ft.

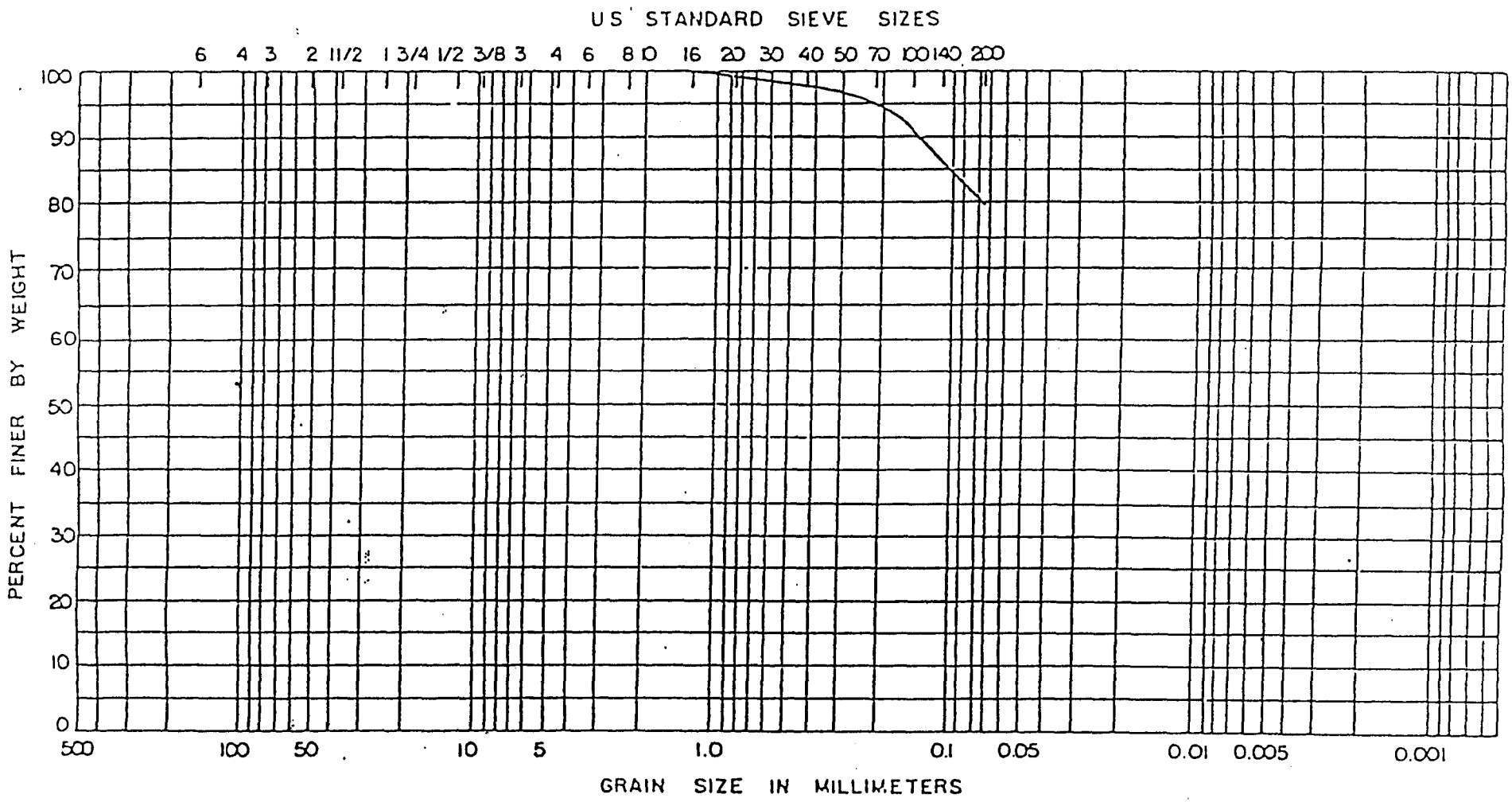
evelopment Method: Air comp. Screen: ~~0.015-in slot, thd 23-28 ft.~~ 2-in PVC Sch 40, thd Seal: Bent, 19-21 f

oil Samples: Split-spoon Grout: Portland cem, 0-19 ft.

eophysical Logs: Chem. Analysis:

Elev.	Depth	TOC=1074.27 LS=1071.02 Description	Penetration Resistance (Blows per ft.) 3 10 20 30 40 60 80
		Reddish-brown, SAND, fine-grained, very loose; with some CLAY and abundant muscovite and some wood debris and garbage (FILL).	4
	7	Gray CLAY, very soft; with some very fine SAND and some SILT, and abundant muscovite.	
	12	Gray SAND, fine to mostly medium to coarse, loose, subangular to subrounded with abundant muscovite and some dark minerals. Water table at about 12 ft. in borehole.	5
		Grades to	
	19	Dark gray CLAY, very soft; with SILT and very fine SAND and abundant muscovite.	2
	21	Brownish-gray SAND, very fine to mostly medium to coarse, loose, subangular; with abundant muscovite and dark minerals; with thin lenses of sandy SILT and CLAY.	7
G.S			
			9
	31	Reddish-orange SAND, very fine to medium, subangular, firm arkosic, with abundant muscovite and dark minerals, slightly silty.	
G.S.			1

Boring Terminated @ 35 ft.



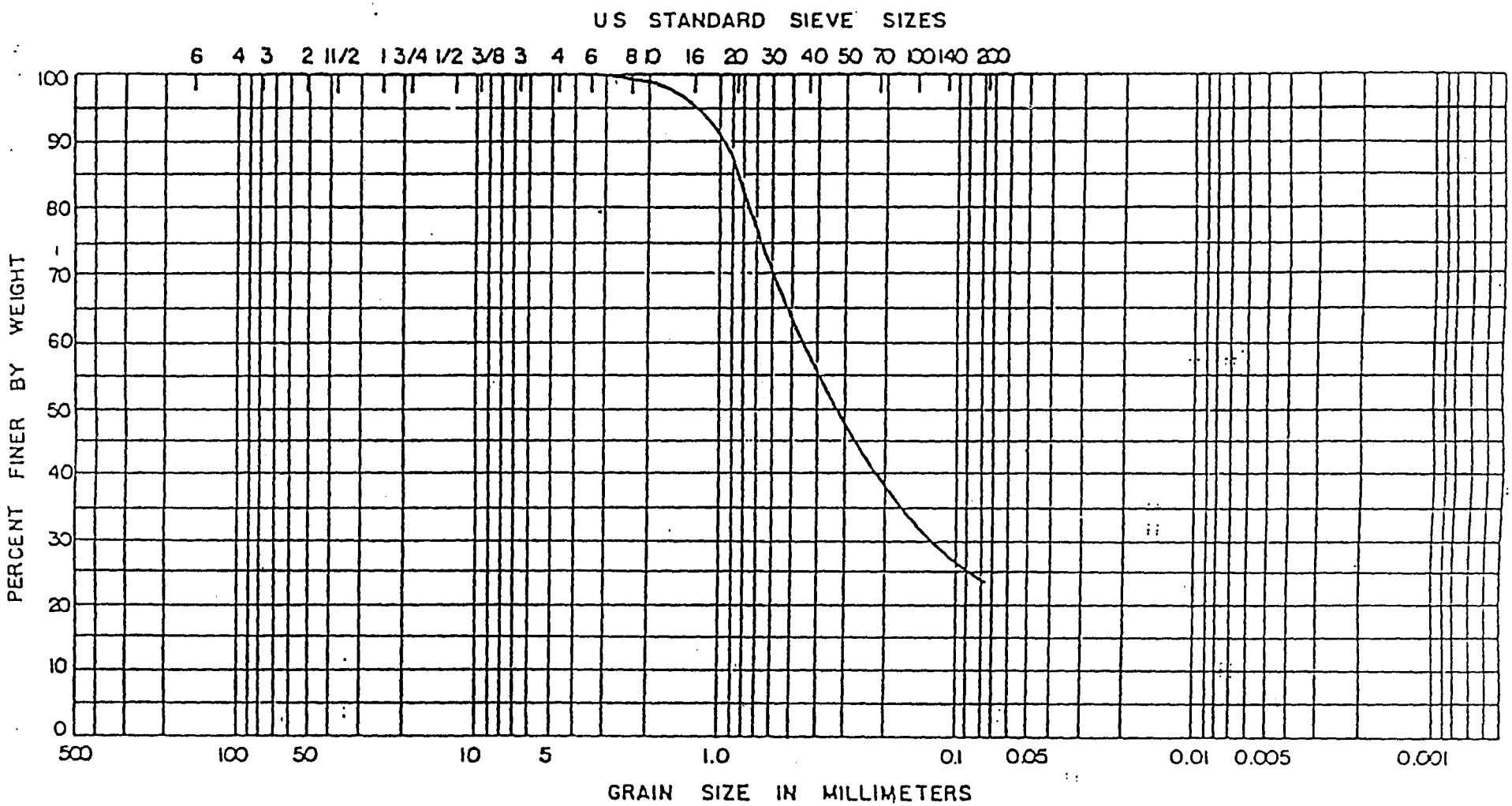
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
W-1B	28.5'-30.0'					UNIT IA Grayish, Slightly Sandy CLAY

GRAIN SIZE DISTRIBUTION

JOB NO. 4482-129

SOIL & MATERIAL ENGII S, INC.



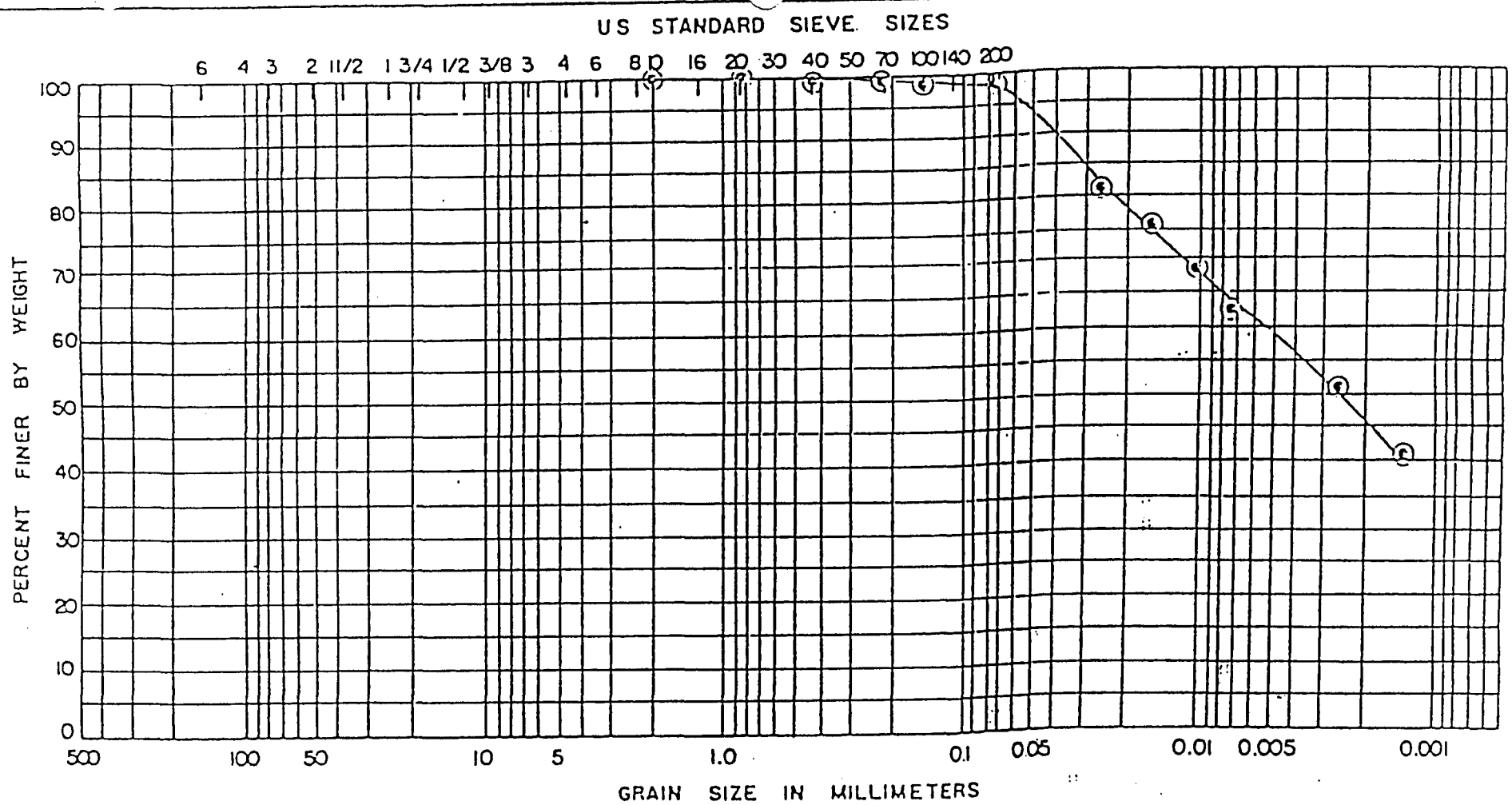
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
E-1	18.5'-20.0'					UNIT 1B Grayish, Silty SAND

GRAIN SIZE DISTRIBUTION

JOB NO. 4482-129

SOIL & MATERIAL ENGINEERS, INC.



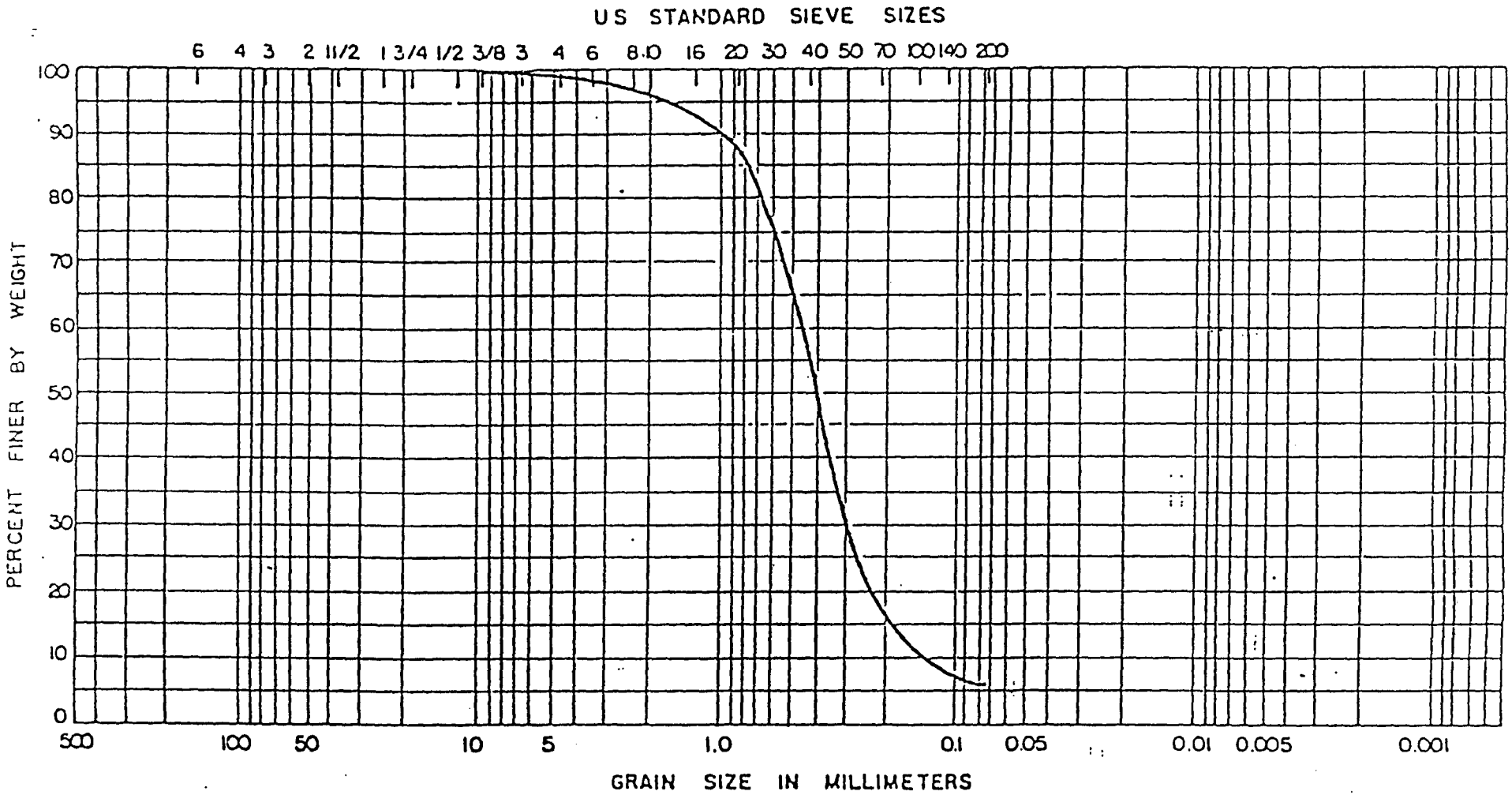
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
NE-1	13.5-15'					Dark Gray Micaceous Slightly Sandy Silty Clay – Highly Plastic

GRAIN SIZE DISTRIBUTION

JOB NO. 4483-129A

SOIL & MATERIAL ENGINEERS, INC.



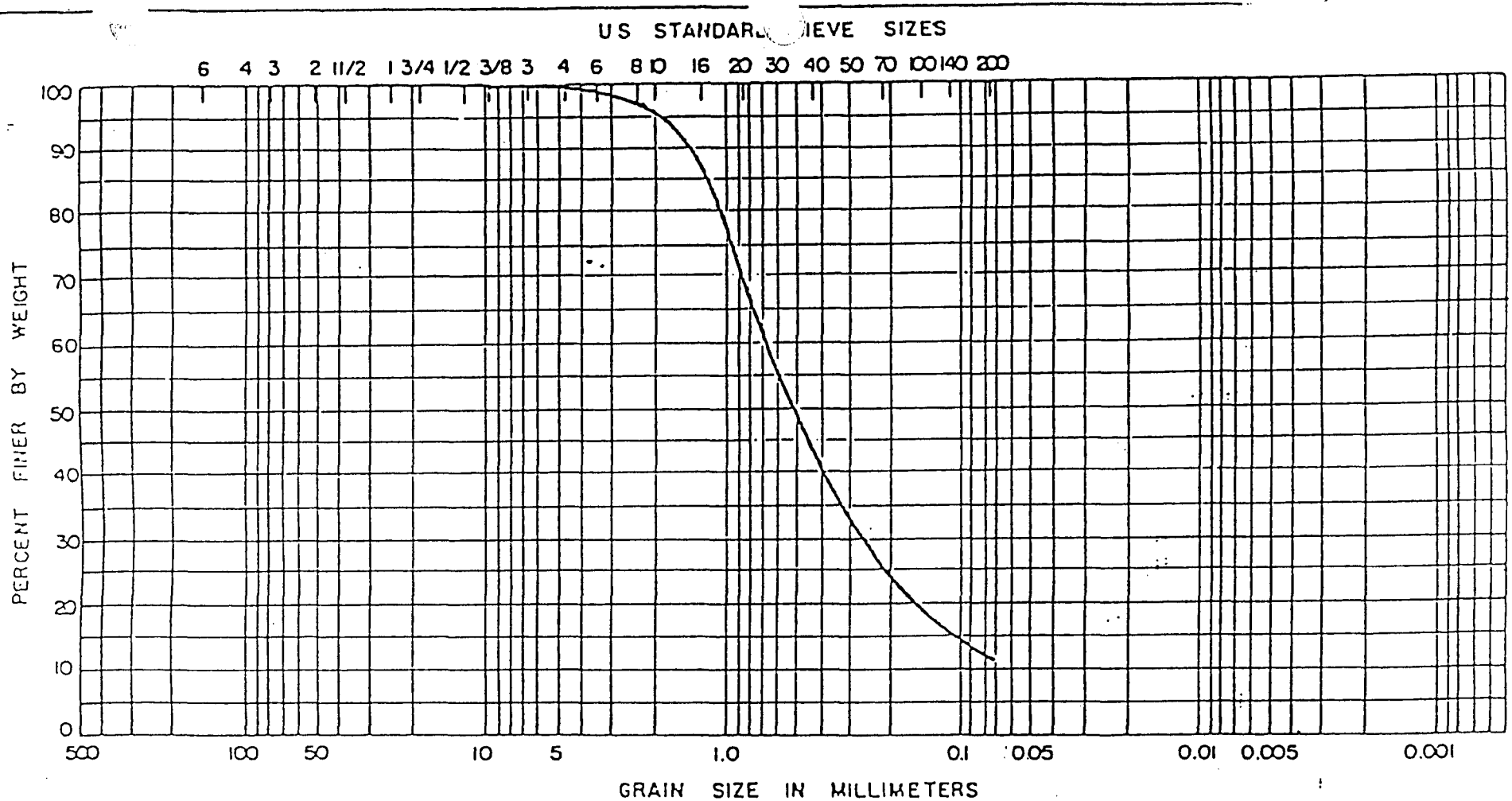
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
W2-7	35'					Brown Clayey SAND

GRAIN SIZE DISTRIBUTION

JOB NO. 4483-129A

SOIL & MATERIAL ENGINEERS, INC.



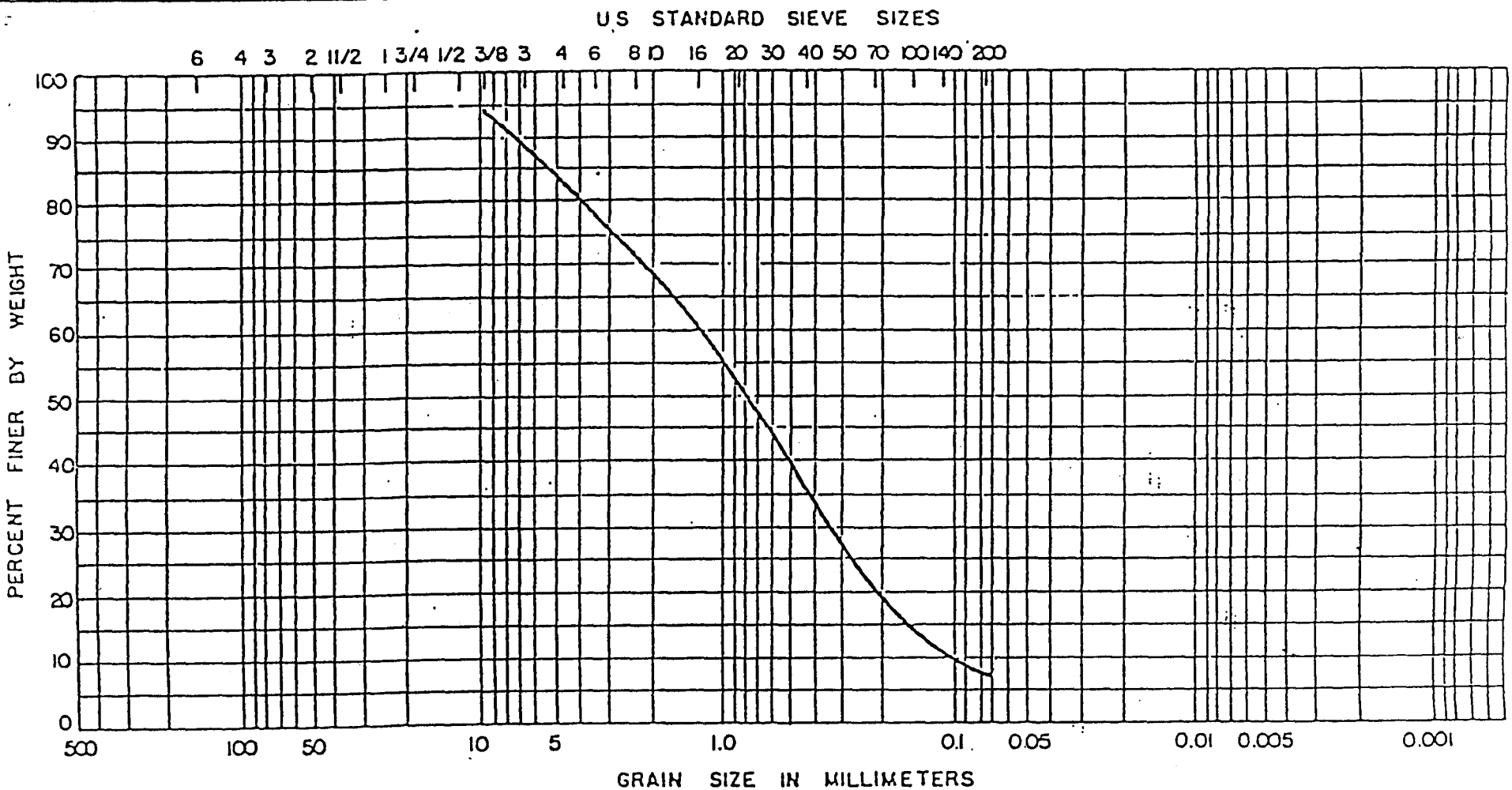
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
W2-5	25'					Gray-Tan Clayey SAND

GRAIN SIZE DISTRIBUTION

JOB NO. 4483-129A

SOIL & MATERIAL ENGINEERS, INC.



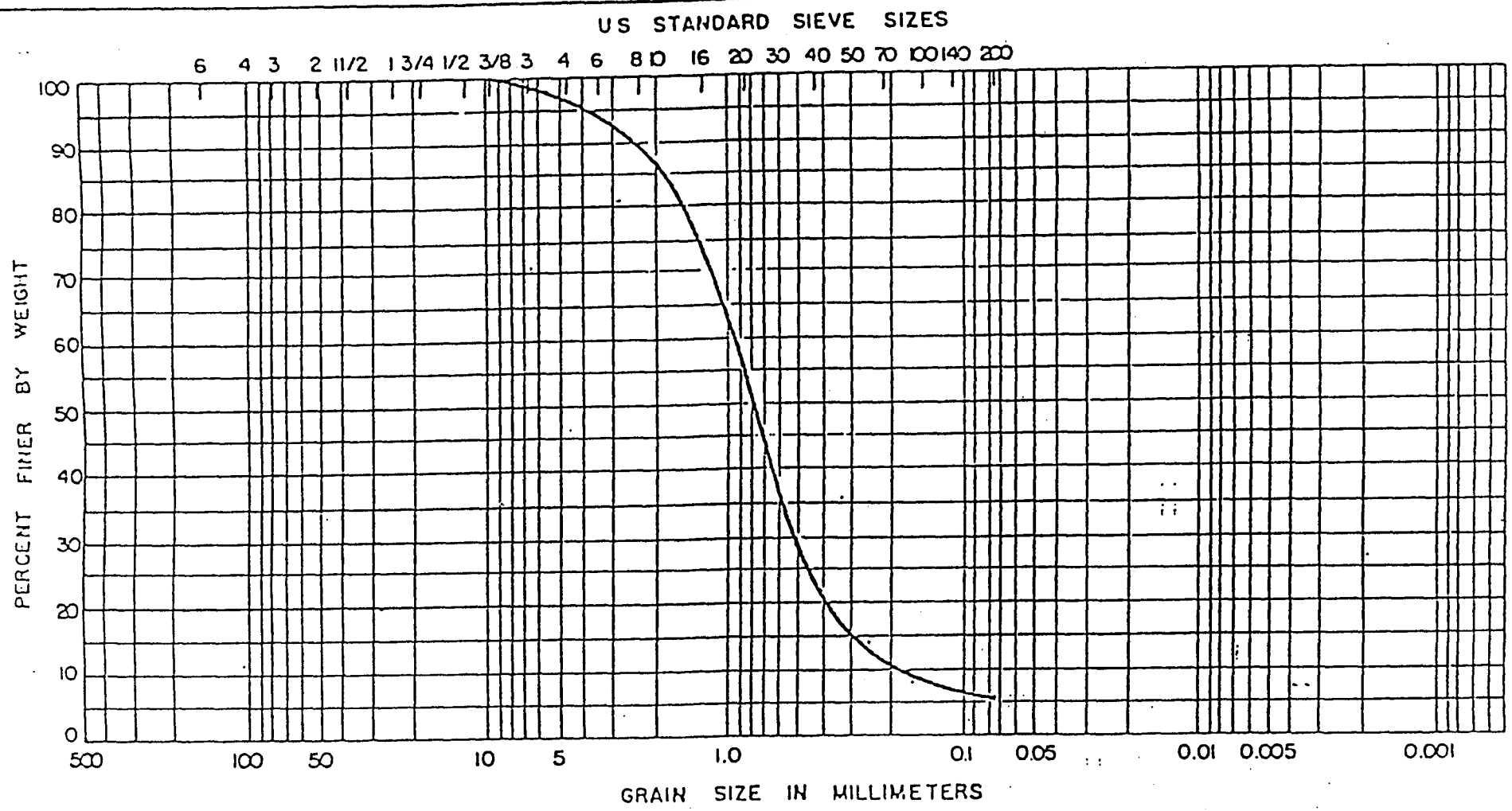
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT W/C	LL	PL	PI	CLASSIFICATION
N2-6	30'					Tan Coarse SAND

GRAIN SIZE DISTRIBUTION

JOB NO. 4483-129A

SOIL & MATERIAL ENGINEERS, INC.



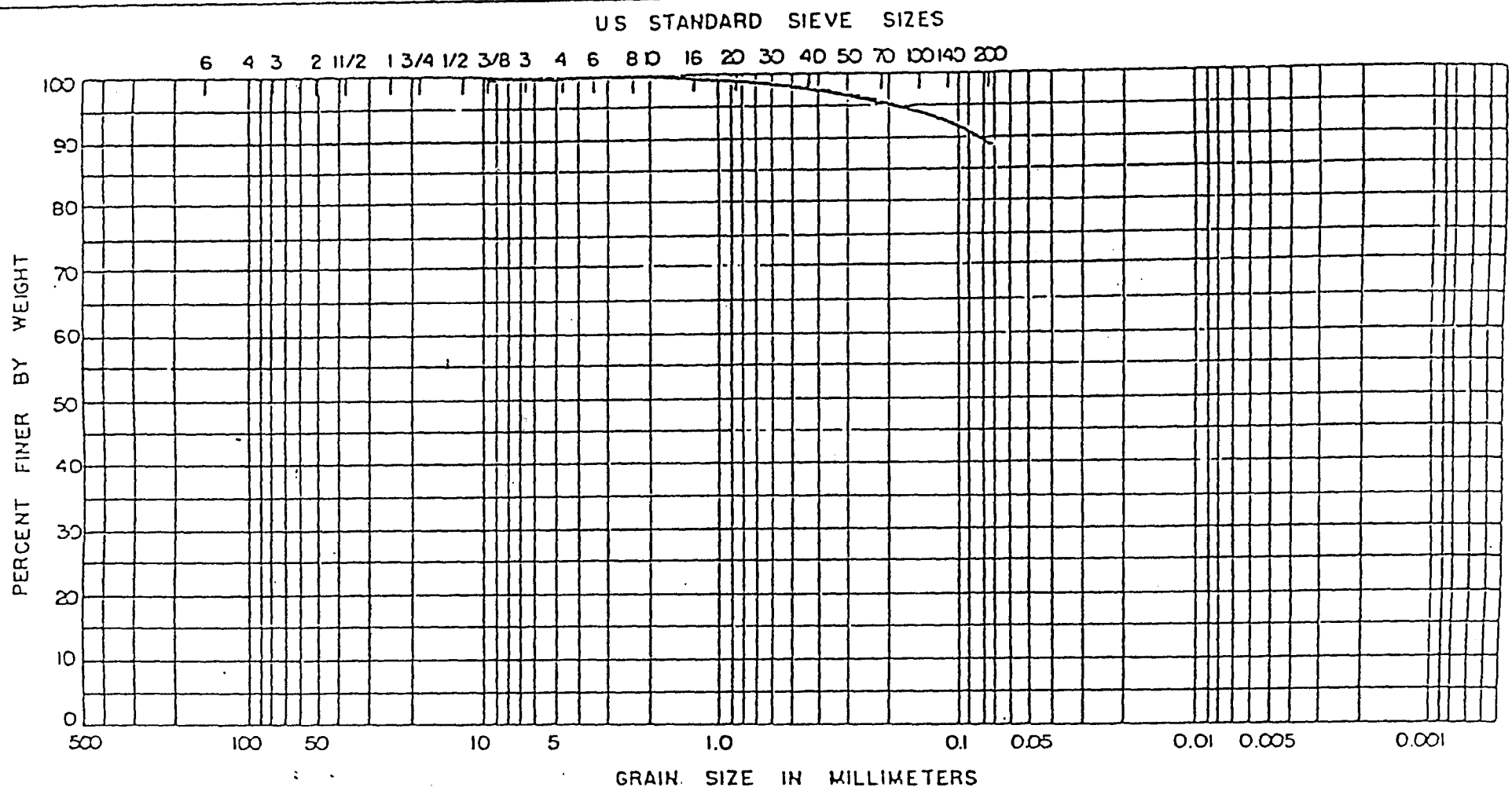
BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI	CLASSIFICATION
NE-1	25'					Yellow Coarse SAND

GRAIN SIZE DISTRIBUTION

JOB NO. 44-83-129A

SOIL & MATERIAL ENGINEERS, INC.



BOULDERS	COBBLES	GRAVEL		SAND			FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	NAT WC	LL	PL	PI.	CLASSIFICATION
N2-5	25'					Gray Silty Sandy CLAY

GRAIN SIZE DISTRIBUTION

JOB NO. 44-83-129A

SOIL & MATERIAL ENGINEERS, INC.

WELL RECORD
Monitor Well N-2

DIVISION OF ENVIRONMENTAL MANAGEMENT
P. O. Box 27687 - RALEIGH, N.C. 27611 919-733-2020

DRILLING CONTRACTOR Soil & Material Engrg. REG. NO. 412 WELL CONSTRUCTION PERMIT NO.
Columbia, S.C.

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: Lenior County: Caldwell

Singer Co. Plant No. 3 Near Virginia St. Quadrangle No. Lenior, N.C.

(Road, Community or Subdivision and Lot No.)

Well Grid No. J47-g

2. OWNER: Singer Company

3. ADDRESS: P.O. Box 1588, Lenior, N.C. 28645

4. TOPOGRAPHY: drain, valley, slope, hilltop, flat (circle one)

5. USE OF WELL: Monitoring DATE: 8/2/83

6. DOES THIS WELL REPLACE AN EXISTING WELL? No

7. TOTAL DEPTH: 20 ft RIG TYPE OR METHOD: Mud Rotary

8. FORMATION SAMPLES COLLECTED: YES X NO

9. CASING:

	Depth		Inside Dia.	Wall thick. or weight/ft.	type
From 0	to 10	ft	2-in	Sch. 40	PVC

10. GROUT:

	Depth		Material	Method
From 0	to 6	ft	Portland Cem	Gravity
6	8		Bentonite Seal	Gravity

11. SCREEN:

	Depth		Dia.	Type & Opening
From 10.0	to 20.0	ft	2-in	PVC 0.015-in

12. GRAVEL:

	Depth		Size	Material
From 8	to 20	ft		Quartz sand

13. WATER ZONES (depth): 10-22 ft; 26-35 ft.

14. STATIC WATER LEVEL: 10.6 ft. above/below top of casing

Casing is 3.35 ft. above land surface ELEV: ±1064

15. YIELD (gpm): NA METHOD OF TESTING:

16. PUMPING WATER LEVEL: NA ft.

after hours at gpm.

17. CHLORINATION: Type NONE Amount

18. WATER QUALITY: TEMPERATURE (°F)

19. PERMANENT PUMP: Date Installed NA

Type Capacity (gpm) HP

Make Intake Depth

Airline Depth

20. HAS THE OWNER BEEN PROVIDED A COPY OF THIS RECORD AND INFORMED OF THE DEPARTMENTS REQUIREMENTS AND RECOMMENDATIONS? yes

21. REMARKS Well used for monitoring purposes only.

I do hereby certify that this well was constructed in accordance with N.C. Well Construction Regulations and Standards and that this well record is true and exact.

SIGNATURE OF CONTRACTOR OR AGENT DATE

Submit original to Division of Environmental Management and copy to well owner

DRILLING LOG

DEPTH FROM	TO	FORMATION DESCRIPTION
		See attached log

If additional space is needed, use back of for

LOCATION SKETCH
(Show distance to numbered roads, or other map reference points)

See attached map with location of all monitor wells at site.

ITOR WELL W-2

WELL RECORD

DIVISION OF ENVIRONMENTAL MANAGEMENT
P. O. Box 27687 - RALEIGH, N.C. 27611 919-733-2020

DRILLING CONTRACTOR Soil & Material, Engr. Co. NO. 412 WELL CONSTRUCTION PERMIT NO.
Columbia, S.C.

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: Lenior County: Caldwell
Singer Co. Plant No. 3 Near Virginia St. Quadrangle No. Lenior, N.C.
(Road, Community or Subdivision and Lot No.) Well Grid No. J47-g6

2. OWNER: Singer Company
3. ADDRESS: P.O. Box 1588, Lenior, N.C. 28645
4. TOPOGRAPHY: draw, valley, slope, hilltop, flat (circle one)
5. USE OF WELL: Monitoring DATE: 8/2/83
6. DOES THIS WELL REPLACE AN EXISTING WELL? NO
7. TOTAL DEPTH: 28 ft. RIG TYPE OR METHOD: Auger
8. FORMATION SAMPLES COLLECTED: YES X NO

DRILLING LOG

DEPTH FROM	TO	FORMATION DESCRIPTION
		See Attached Log

9. CASING:

Depth From	to	Inside Dia.	Wall thick. or weight/ft.	type
0	23 ft	2-in	Sch 40	PVC

10. GROUT:

Depth From	to	Material	Method
0	19 ft	Portland Cem.	Pumped
19	21	Bentonite Seal	Gravity

If additional space is needed, use back of for

11. SCREEN:

Depth From	to	Dia.	Type & Opening
23	28 ft	2-in	PVC 0.015-in

LOCATION SKETCH
(Show distance to numbered roads, or other map reference poi

12. GRAVEL:

Depth From	to	Size	Material
21	28 ft		Quartz Sand

13. WATER ZONES (depth): 12-19 ft; 21-35 ft,

See attached map with location o monitor wells.

14. STATIC WATER LEVEL: 13.5 ft. above/below top of casing
Casing is 3.3 ft. above land surface ELEV: ±1070
15. YIELD (gpm): NA METHOD OF TESTING:
16. PUMPING WATER LEVEL: NA ft.
after hours at gpm.
17. CHLORINATION: Type NONE Amount
18. WATER QUALITY: TEMPERATURE (°F)
19. PERMANENT PUMP: Date Installed NONE
Type Capacity (gpm) HP
Make Intake Depth
Airline Depth
20. HAS THE OWNER BEEN PROVIDED A COPY OF THIS RECORD AND INFORMED OF THE DEPARTMENTS REQUIREMENTS AN RECOMMENDATIONS? Yes
21. REMARKS Well to be used for monitoring only.

I do hereby certify that this well was constructed in accordance with N.C. Well Construction Regulations and Standards and that this well record is true and exact.

SIGNATURE OF CONTRACTOR OR AGENT DATE

Division of Environmental Management and copy to well c

NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES & COMMUNITY DEVELOPMENT
DIVISION OF ENVIRONMENTAL MANAGEMENT
RALEIGH, N.C. 27611 919-733-2020

WELL RECORD

Well NE-1

DRILLING CONTRACTOR Soil & Material Engr. Columbia, S.C. REG. NO. 412 WELL CONSTRUCTION PERMIT NO.

1. WELL LOCATION: (Show sketch of the location below)

Nearest Town: Lenior County: Caldwell

Singer Co. Plant No. 3 near Virginia St. Quadrangle No. Lenior, N.C.

(Road, Community or Subdivision and Lot No.) Well Grid No. J47-g8

2. OWNER: Singer Company

3. ADDRESS: P.O. Box 1588, Lenior N.C. 28649

4. TOPOGRAPHY: draw, valley, slope, hilltop, flat (circle one)

5. USE OF WELL: Monitoring DATE: 8/3/83

6. DOES THIS WELL REPLACE AN EXISTING WELL? No

7. TOTAL DEPTH: 30.3 RIG TYPE OR METHOD: Auger

8. FORMATION SAMPLES COLLECTED: YES X NO

9. CASING:

	Depth		Inside Dia.	Wall thick. or weight/ft.	type
From 0	to 25.3 ft		2-in	Sch 40	PVC

10. GROUT:

	Depth		Material	Method
From 0	to 19 ft		Portland Cem	Pump

11. SCREEN:

	Depth		Dia.	Type & Opening
From 25.3	to 30.3 ft		2-in.	PVC 0.015-in

12. GRAVEL:

	Depth		Size	Material
From 23	to 31 ft			Quartz Sand

13. WATER ZONES (depth): 17-21 ft; 23-35 ft.

14. STATIC WATER LEVEL: 5.5 ft. above/below top of casing

Casing is 2.7 ft. above land surface ELEV: ±1067

15. YIELD (gpm): NA METHOD OF TESTING:

16. PUMPING WATER LEVEL: NA ft.

after hours at gpm.

17. CHLORINATION: Type NONE Amount

18. WATER QUALITY: TEMPERATURE (°F)

19. PERMANENT PUMP: Date Installed NONE

Type Capacity (gpm) HP

Make Intake Depth

Airline Depth

20. HAS THE OWNER BEEN PROVIDED A COPY OF THIS RECORD AND INFORMED OF THE DEPARTMENTS REQUIREMENTS AND RECOMMENDATIONS? yes

21. REMARKS Well is for monitoring use only

I do hereby certify that this well was constructed in accordance with N.C. Well Construction Regulations and Standards and that this well record is true and exact.

SIGNATURE OF CONTRACTOR OR AGENT DATE

DRILLING LOG

DEPTH FROM	TO	FORMATION DESCRIPTI
		See attached log

If additional space is needed, use back of for

LOCATION SKETCH
(Show distance to numbered roads, or other map reference

See attached map with locations of monitor wells.

Chemists & Engineers
GREENVILLE, S. C.

WATER ANALYSIS

Job No. F-1003

CLIENT The Singer Company — Date Received 8-8-83

ADDRESS Lenoir, NC — Date Completed 8-19-83

Date Transmitted 8-29-83

Sample	Analysis No.	Identification
I	40947	Landfill Monitoring Well N-2 taken 11:25 a.m. 8-8-83
II	40948	" " " NE-1 taken 10:15 a.m. 8-8-83
III	40949	" " " W-2 taken 12:10 a.m. 8-8-83
IV		
V		

APHA Standard Methods used unless otherwise noted.

Constituents, ppm			as	I	II	III	IV	V
CATIONS	Calcium	Ca	$CaCO_3$					
	Magnesium	Mg	" "					
	Sodium	Na	" "					
	Potassium	K	" "					
			" "					
	Total Cations		" "					
ANIONS	Bicarbonate	HCO_3	" "					
	Carbonate	CO_3	" "					
	Hydroxide	OH	" "					
	Chlorides	Cl	Cl	20.6	4.9	14.4		
	Sulfates	SO_4	SO_4	13	12	14		
	Nitrates	NO_3	N	0.1	0.86	0.43		
	Total Anions							
Total Hardness			" "					
Alkalinity Methyl Orange			" "					
Alkalinity Phenolphthalein			" "					
pH				6.8	6.5	6.5		
Total Solids (By Evaporation)								
Free Carbon Dioxide			CO_2					
Silica			SiO_2					
Total Iron			Fe					
Manganese			Mn					
Aluminum			Al					
Phosphate			PO_4					
Sulfite			SO_3					
Chemical Oxygen Demand (COD)			O					
Turbidity								
Color								
Specific Conductivity			mmhos/cm	370	130	210		
Total Dissolved Solids				238	207	215		
Total Dissolved Organic Carbon				4.59	1.93	3.19		

Remarks:

By Baskin

Analyst

September 18, 1983

TECHNICAL REPORT

for

J. Serrine Company
P.O. Box 5456
216 S. Pleasantburgh Dr.
Greenville, SC 29606

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7627	J. Serrine Company	SINGLENLF	WN2	830808	1125	

ENVIRONMENTAL TESTING and CERTIFICATION CORPORATION

Dennis C. K. Lin, Ph.D.
Vice President
Research and Operations

September 17, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds – GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7627	J. SERRINE COMPANY	SINGLENLF	WN2	830808	1125	

NPDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l*	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Concen. Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Sample ug/l	QC Matrix Spike: Concen. Added ug/l	QC Matrix Spike: % Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	85	ND	1600	74
2V	Acrylonitrile	ND	100	ND	ND	ND	160	84	ND	160	88
3V	Benzene	ND	10	ND	3	ND	36	89	ND	36	90
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	10	ND	ND	ND	36	100	ND	36	94
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	97	ND	36	104
7V	Chlorobenzene	ND	10	ND	2	ND	36	94	ND	36	103
8V	Chlorodibromomethane	ND	10	ND	ND	ND	36	101	ND	36	99
9V	Chloroethane	ND	10	ND	ND	ND	36	102	ND	36	106
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	105	ND	36	97
11V	Chloroform	ND	10	ND	ND	ND	36	96	ND	36	96
12V	Dichlorobromomethane	ND	10	ND	ND	ND	36	101	ND	36	93
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
14V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	86	ND	36	87
15V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	91	ND	36	88
16V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	86	ND	36	88
17V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	79	ND	36	79
18V	1,3-Dichloropropylene	ND	10	ND	ND	ND	36	73	ND	36	81
19V	Ethylbenzene	ND	10	ND	ND	ND	36	96	ND	36	96
20V	Methyl bromide	ND	10	ND	ND	ND	36	102	ND	36	102
21V	Methyl chloride	ND	10	ND	ND	ND	36	90	ND	36	103
22V	Methylene chloride	BDL	10	ND	ND	BDL	36	78	9	36	42
23V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	92	ND	36	86
24V	Tetrachloroethylene	ND	10	ND	ND	ND	36	99	ND	36	103
25V	Toluene	ND	10	ND	ND	ND	36	92	BDL 2	36	87
26V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	88	ND	36	81
27V	1,1,1-Trichloroethane	ND	10	4	4	ND	36	97	ND	36	100
28V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	98	ND	36	91
29V	Trichloroethylene	ND	10	ND	ND	ND	36	92	ND	36	94
30V	Trichlorofluoromethane	BDL	10	ND	ND	ND	36	96	18	36	51
31V	Vinyl chloride	ND	10	ND	ND	ND	36	97	ND	36	103

* EPA published Method Detection Limit

INTRODUCTION

This report contains the analytical results on your water sample, WN2 830808 1125, submitted on August 10, 1983. It is designed to satisfy the needs of your people at various levels in your organization.

The results we obtained on your sample are presented in a tabular format immediately after this introduction. Included with the sample results, the quality assurance data on your specific sample are tabulated to verify the validity of the results obtained. The quality assurance data include those obtained on the surrogates, the blank, the spiked blank, the replicate and the spiked sample (commonly known as matrix spike). Also presented in the quality assurance data report is the verification of the proper functioning of the instruments used. The gas chromatograms and/or mass spectra generated in the analysis of your sample are included in the Appendix of the report. The chain of custody record for your sample is included at the end of this report.

The established methods we used in the analysis of your sample are described in the Methodology section after the Results. In the analysis we followed a rigidly controlled Quality Assurance Protocol. This Protocol is described after the Methodology section.

We hope our report format is useful in assisting you to obtain pertinent information on your sample.

RESULTS

The results obtained on your sample and the accompanying quality assurance data are listed in Table 1. The compounds of interest are listed with their NPDES (National Pollution Discharge Elimination System) number, and Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound is detected below its MDL it is reported in Table 1 as BMDL (Below Method Detection Limit). When a compound is searched for and cannot be found it is reported as ND (Not Detected). The quality assurance data include results obtained on the Method Blank, Spiked Blank, Replicate, and Matrix Spike analyses. However, since the Replicate and Matrix Spike analyses were performed on samples randomly chosen in a sample batch, your specific sample may not be the selected one.

The data on the recovery of the surrogates in your sample and the certification of the GC/MS systems used in the analysis of your sample are listed in Table 2.

The Chain-of-Custody Record on your sample is also included at the end of this Report.

September 17, 1983

TABLE 1: QUANTITATIVE RESULTS

Metals, Cyanide and Phenols – Analysis Data (QR05)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7627	J. SERRINE COMPANY	SINGLENLF	WN2	830808	1125	

NPDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l
1M	Antimony	ND	200
2M	Arsenic	ND	200
3M	Beryllium	ND	6
4M	Cadmium	ND	20
5M	Chromium	BDL	30
6M	Copper	BDL	10
7M	Lead	ND	100
8M	Mercury	BDL	0.3
9M	Nickel	ND	20
10M	Selenium	ND	200
11M	Silver	ND	20
12M	Thallium	-	-
13M	Zinc	250	9
14M	Cyanide, Total	-	-
15M	Phenolics, Total	-	-
	Aluminum	BDL	100
	Boron	ND	40
	Barium	80	6
	Calcium	50000	1000
	Cobalt	ND	60
	Iron	ND	200
	Magnesium	8000	1000
	Manganese	610	7
	Molybdenum	ND	40
	Sodium	18000	1000
	Tin	ND	200
	Titanium	ND	7
	Vanadium	ND	9

September 18, 1983

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery – GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7627

ETC Sample No. Company Facility Sample Point Date Time Elapsed Hours

Compound	Amount Added ug	% Recovery	Control Limits * Lower	Control Limits * Upper
VOLATILE FRACTION				
Bromochloromethane	.200	97	79	127
Benzene, d_6	.150	120	63	122
Fluorobenzene	.150	117	74	122
1,4-Dichlorobutane	.200	98	75	117
Pentafluorobenzene	.150	147	58	124
Ethylbenzene, d_{10}	.150	125	78	114
ACID FRACTION				
2-Fluorophenol	80	64	20	86
Pentafluorophenol	80	80	37	127
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	81	62	122
1-Fluoronaphthalene	80	87	64	104
Nitrobenzene, d_5	80	99	58	105

* Three Standard Deviations About the Mean.

September 18, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Base/Neutral Compounds – GC/MS Analysis Data (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7627	J. SERRINE COMPANY	SINGLENLF	WN2	830808	1125	

NPDES Number	Compound	Results: Sample Concen ug/l	Results: MDL ug/l*	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Concen. Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Extract ug/l	QC Matrix Spike: Concen. Added ug/l	QC Matrix Spike: % Recov
15	Acenaphthene	ND	10	ND	ND	ND	100	97	ND	100	99
28	Acenaphthylene	ND	10	ND	ND	ND	100	93	ND	100	93
38	Anthracene	ND	10	ND	ND	ND	100	108	ND	100	108
48	Benzidine	ND	10	ND	ND	ND	100	33	ND	100	26
58	Benzo(a)anthracene	ND	10	ND	ND	ND	100	105	ND	100	98
68	Benzo(a)pyrene	ND	10	ND	ND	ND	100	137	ND	100	109
78	Benzo(b)fluoranthene	ND	10	ND	ND	ND	100	95	ND	100	120
88	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
93	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	109	ND	100	85
108	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	110	ND	100	111
118	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	108	ND	100	115
128	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	119	ND	100	149
138	bis(2-Ethylhexyl)phthalate	BDL	10	ND	ND	ND	100	133	ND	100	117
148	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	113	ND	100	110
158	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	128	ND	100	135
168	2-Chloronaphthalene	ND	10	ND	ND	ND	100	82	ND	100	85
178	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	138	ND	100	136
183	Chrysene	ND	10	ND	ND	ND	100	162	ND	100	122
198	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
208	1,2-Dichlorobenzene	ND	10	ND	ND	ND	100	95	ND	100	93
218	1,3-Dichlorobenzene	ND	10	ND	ND	ND	100	102	ND	100	110
228	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	74	ND	100	80
238	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	51	ND	100	66
248	Diethyl phthalate	ND	10	ND	ND	ND	100	18	ND	100	94
258	Dimethyl phthalate	ND	10	ND	ND	ND	100	6	ND	100	17
268	Di-n-butyl phthalate	ND	10	ND	ND	11	100	103	ND	100	135
278	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	99	ND	100	98
288	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	103	ND	100	100
298	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	109	ND	100	147
308	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	112	ND	100	110
318	Fluoranthene	ND	10	ND	ND	ND	100	110	ND	100	107

* EPA Published Method Detection Limit

September 16, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds - GC/MS Analysis Data (QR02)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7621	J. SERRINE COMPANY	SINGLENLF	WN2	830808	1125	

NPDES Number	Compound	Results: Sample Concen ug/l	Results: MDL ug/l*	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Amount Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Extract ug/l	QC Matrix Spike: Amount Added ug/l	QC Matrix Spike: % Recov
1A	2-Chlorophenol	25	25	25	25	25	150	69	25	153	63
2A	2,4-Dichlorophenol	25	25	25	25	25	150	75	25	153	74
3A	2,4-Dimethylphenol	25	25	25	25	25	0	-	25	0	-
4A	4,6-Dinitro-o-cresol	25	250	25	25	25	250	61	25	255	100
5A	2,4-Dinitrophenol	25	250	25	25	25	0	-	25	0	-
6A	2-Nitrophenol	25	25	25	25	25	150	70	25	153	69
7A	4-Nitrophenol	25	25	25	25	25	150	95	25	153	107
8A	p-Chloro-m-cresol	25	25	25	25	25	150	53	25	153	53
9A	Pentachlorophenol	25	25	25	25	25	150	85	25	153	101
10A	Phenol	25	25	25	25	25	150	63	25	153	51
11A	2,4,6-Trichlorophenol	25	25	25	25	25	150	78	25	153	82

* EPA published Method Detection Limit

August 30, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Bromofluorobenzene (BFB) for Volatiles Analysis (OR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7627

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of the base peak	29
75	30-60% of the base peak	54
95	Base Peak, 100% relative abundance	100
96	5-9% of the base peak	7
173	Less than 1% of the base peak	1
174	Greater than 50% of the base peak	65
175	5-9% of mass 174	6
176	Greater than 50% of the base peak	63
177	5-9% of mass 176	6

Date: 082283
Run No: 7384
Spectrum No: 27
Analyst: P. Krajczar

September 14, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7627

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	42
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	45
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	21
365	Greater than 1% of mass 198	2
441	Less than mass 443	14
442	Greater than 40% of mass 198	91
443	17-23% of mass 442	18

Date: 830907
Run No: 6954
Spectrum No: 124
Analyst: K. Weiner

September 18, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphosphine (DFTPP) for Base/Neutrals Analysis (QR23)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7627

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	42
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	45
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	21
365	Greater than 1% of mass 198	2
441	Less than mass 443	14
442	Greater than 40% of mass 198	91
443	17-23% of mass 442	18

Date: 090783
Run No: 6953
Spectrum No: 124
Analyst: K.R. Weiner

METHODOLOGY

The methods employed in the analysis of your sample are established EPA methods for priority pollutants. Combined gas chromatography and mass spectrometry (GC/MS) was used in the analysis of the organic compounds and atomic absorption spectrophotometry (AA) in the analysis of the metals.

For the analysis of the volatile organic compounds, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5-ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back flushed with helium to desorb the purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a mass spectrometer.

For the analysis of the Acid and Base/Neutral priority pollutants, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1-liter, was serially extracted with methylene chloride at a pH greater than 11 and again at pH less than 2 using a separatory funnel or a continuous extractor. The two methylene chloride extracts were individually dried and concentrated to a volume of 1 ml. The concentrates were injected into GC/MS systems set specifically for the separation and measurement of the priority pollutants.

Qualitative identification of the priority pollutants was performed initially using the relative retention times, the relative abundance of three characteristic ions and their ratios. The entire mass spectrum was reviewed before an identification was recorded. Quantitative analysis was performed using an internal standard with a single characteristic ion.

ANALYSIS OF METALS

AQUEOUS

The determination of metals in aqueous samples was performed according to the methods published by EPA in "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March, 1979, and Appendix IV of the Federal Register, December 3, 1979. Arsenic, selenium and thallium were determined by furnace AA; silver, aluminum, barium, beryllium, boron, cadmium, calcium, chromium, copper, cobalt, iron, magnesium, manganese, molybdenum, nickel, lead, sodium, antimony, tin, titanium, vanadium, and zinc were determined by ICP emission spectrometry, except where lower levels of detection were required: In these cases (e.g. lead in groundwater monitoring samples) furnace AA was used. The determination of mercury was performed by cold vapor AA.

EP TOXICITY

The determination of metals in aqueous EP Toxicity leachates was performed according to the methods published by EPA in "Test Methods for Evaluating Solid Waste" EPA SW-846, July 1982, and Appendix IV of the Fed. Reg., Dec. 3, 1979. Silver, arsenic, barium, cadmium, chromium, lead and selenium were determined by ICP emission spectrometry. Mercury was determined using cold vapor AA. For leachates that are organic in nature, the analyses were performed according to the methods described under "OIL/SLUDGE," below.

SOIL/SEDIMENT

The determination of silver, beryllium, cadmium, chromium, copper, nickel, antimony, lead, and zinc in sediment samples was performed according to methods published by EPA in "Interim Methods for the Sampling and Analysis of Priority Pollutants in Sediments and Fish Tissue", EPA 600/4-81-055, October 1980. Mercury was determined according to the sediment method published by EPA in "Method for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, March 1979. Arsenic, selenium and thallium were determined by furnace AA using nitric acid in a closed decomposition vessel for sample digestion.

OIL/SLUDGE

The determination of silver, aluminum, boron, barium, beryllium, calcium, cadmium, copper, chromium, cobalt, iron, magnesium, manganese, molybdenum, sodium, nickel, lead, antimony, tin, titanium, vanadium, and zinc in sludge/petroleum-based samples was performed by ICP emission spectrometry using a magnesium nitrate dry ashing digestion technique.

Arsenic, selenium and thallium were determined by furnace AA using nitric acid in a closed decomposition vessel for sample digestion. Mercury was determined by cold vapor AA using the same digestion technique.

QUALITY ASSURANCE PROTOCOL

The quality assurance protocol followed in the analysis of your sample is based on the "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March, 1979; National Enforcement Investigation Center Policies and Procedures manual; EPA-330/9/79/001-R, October, 1979; and the recommended guidelines for EPA Method 624 and 625.

Our protocol calls for a higher percentage of quality assurance samples than the requirements of Method 624 and 625. The key QA elements for the analysis of priority pollutants are summarized as follows:

Method 624

- In every block of 10 samples, analysis of 7 field samples, one blank, one spiked sample and one replicate are performed. This amounts to a 30% quality control factor.
- A minimum of three surrogate compounds are added to each sample in the block of ten.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- The GC/MS is checked and retuned, if necessary, every eight hours to ensure its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a minimum of 3 concentrations of a standard mixture of the priority pollutants of interest and 3 internal standards (at a constant concentration).
- The calibration curve is verified with a standard priority pollutant mixture every eight hours.
- Results meet the acceptance criteria given in Method 624.

Method 625

- In every block of 20 samples extracted, there are 16 field samples, one blank, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate field sample.
- Five surrogate compounds are added to each sample in the block of 20.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- The GC/MS is checked and retuned, if necessary, every eight hours to ensure its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- GC performance criteria as specified in Method 625 are met before analysis starts.
- A calibration curve for quantitation is prepared using a minimum of 3 concentrations of a standard mixture of the priority pollutants of interest and 2,2'-difluorobiphenyl as internal standard.
- The calibration curve is verified with a standard priority pollutant mixture every eight hours.
- Results meet the acceptance criteria given in Method 625.

Analysis of Metals (Standards)

- New working standards are prepared for each batch of samples.
- Normal calibration is performed using a blank and four standards that have been carried through the entire sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis in the standard additions technique, a three point calibration is performed using U. S. EPA Methods for Chemical Analysis of Water and Wastes, 1979. Results are obtained using linear regression analysis. Any results obtained with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- Normal calibration curves are constructed using greater than or equal to 5 times the Instrumental Detection Limit (IDL) as the lowest concentration level.
- All calibration standards are analyzed in duplicate, as a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to establish the validity of the normal calibration curve.

Analysis of Metals (Sample, for all metals except Mercury)

For all homogeneous samples (minimum of 42% QC), each sample batch may include up to 30 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

For all heterogeneous samples (minimum of 65% QC), every field sample in a sample batch is run in duplicate. A sample batch may include up to 30 samples and the following fixed number of QC samples:

- 4 Replicates.
- 4 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

Analysis of Metals (Sample, Mercury)

For every matrix (minimum of 66% QC), all the field samples in each sample batch are run in duplicate. A sample batch may include up to 20 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 10 Calibration standards (processed using the sample preparation method).
- 2 Blanks.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person(s) breaking the seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;
- disposition of each sample to an analyst or technician and;
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody;
- the time and date each person accepted or relinquished custody.

REPORT APPENDICES

The following appendices provide the support analytical data associated with your sample analyses. They are arranged as follows:

Appendix A

1) Reconstructed total ion chromatogram of GC/MS analyses of your sample.

2) The individual mass spectra of all priority pollutant compounds which have been identified as being present in your sample.

3) The individual mass spectra of the corresponding compounds as obtained from the standards.

Appendix B

1) The mass spectra of the calibration compounds, 4-bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), as obtained on the date of sample analyses.

Appendix C [for plus 10 and 50% internal standard option]

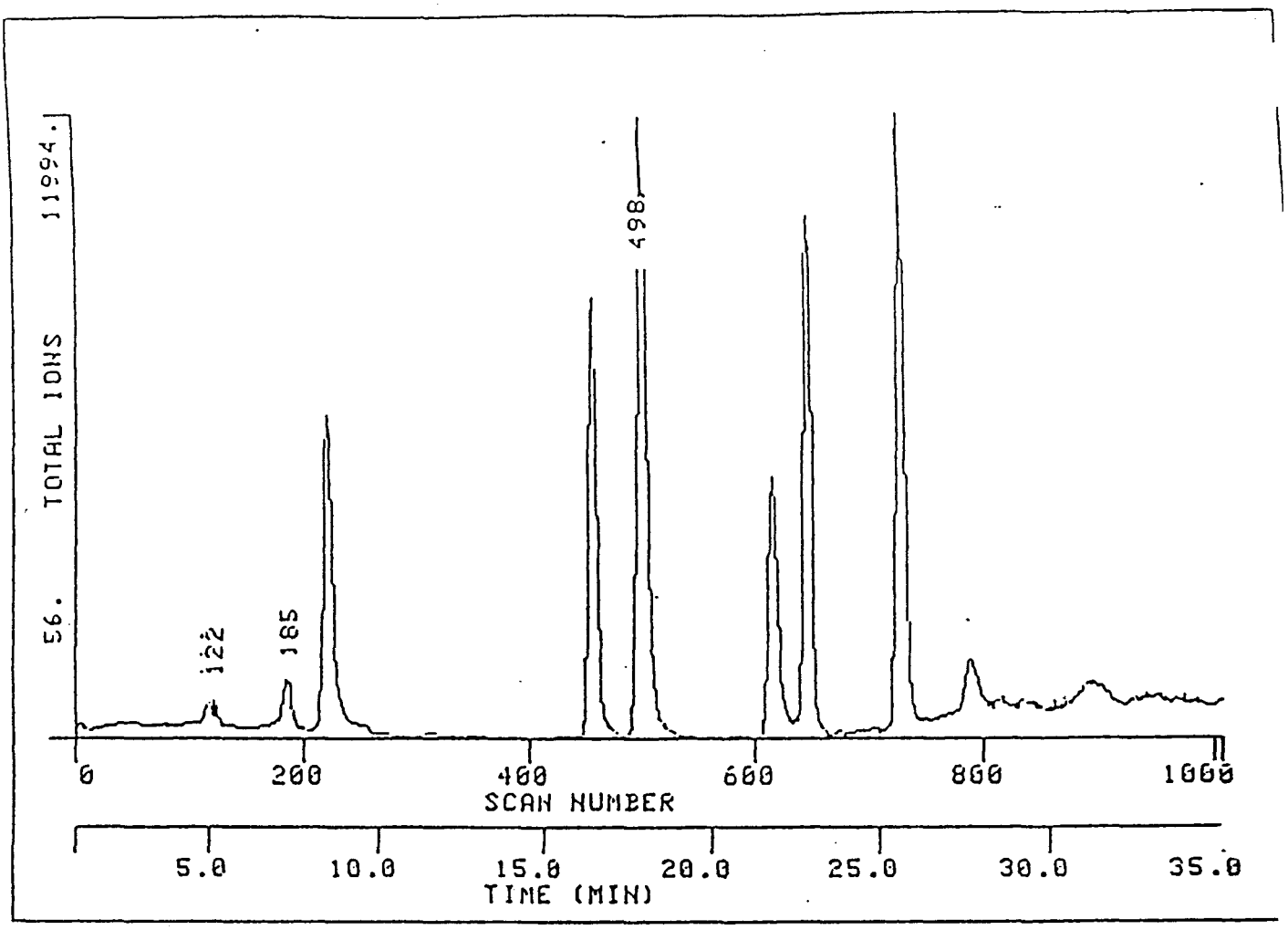
1) Spectra of tentatively identified compounds, with their differences.

Appendix D

1) Subcontractor's report.

These data are provided to present a complete report on your sample and to provide the data on which analytical decisions have been based. We hope this will aid you in your own analysis of the data.

TOTAL ION CHROMATOGRAM



MS Data File FRN: 7394
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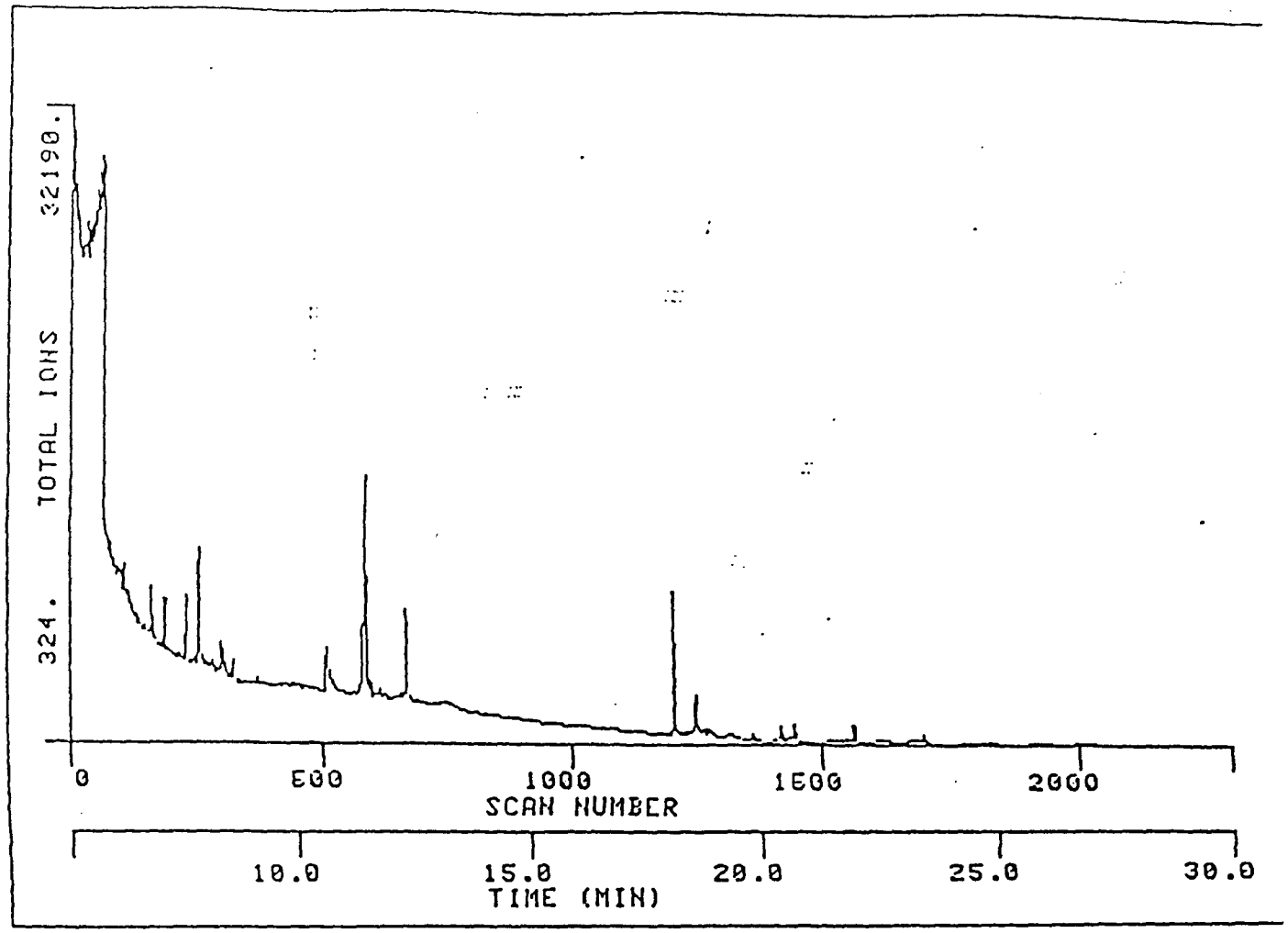
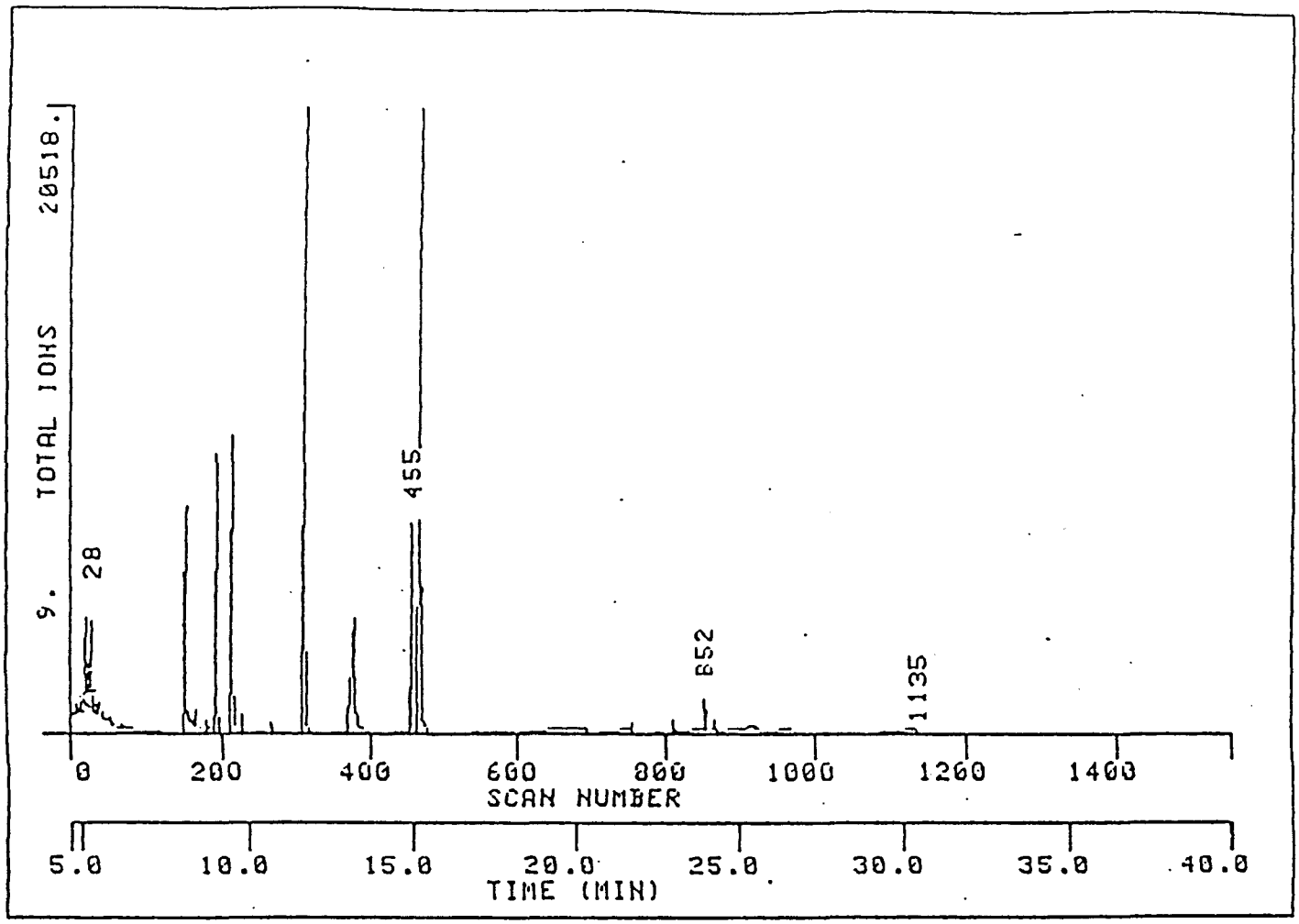
Misc Data: C7627V BTL#6 D7394
Last R.T.: 35.0 minutes

TOTAL ION CHROMATOGRAM



HS Data File FRN: 6970
Name: C7627 ACID FRACTION 830907, F
Misc Data: C7627A BTL#9 D6970
Last R.T.: 30.0 minutes

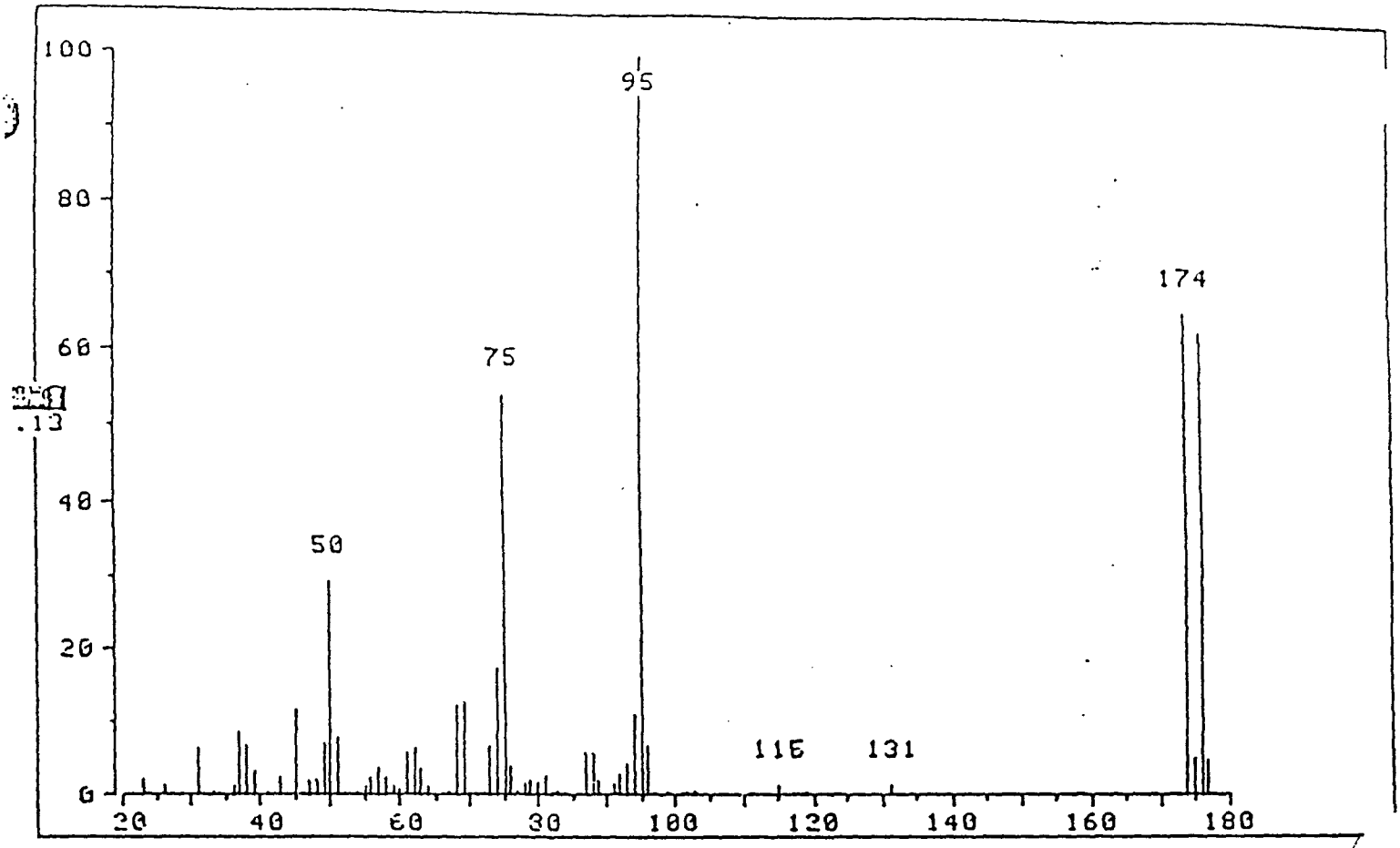
TOTAL ION CHROMATOGRAM



MS Data File FRN: 6987
Name: C7627 BASE/NEUTRAL FRACTION 830907, F
Misc Data: C7627B BTL#26 D6987
Last R.T.: 40.0 minutes

CALIBRATION COMPOUND
5622 GC/MS @ BKC SUB #27

7384



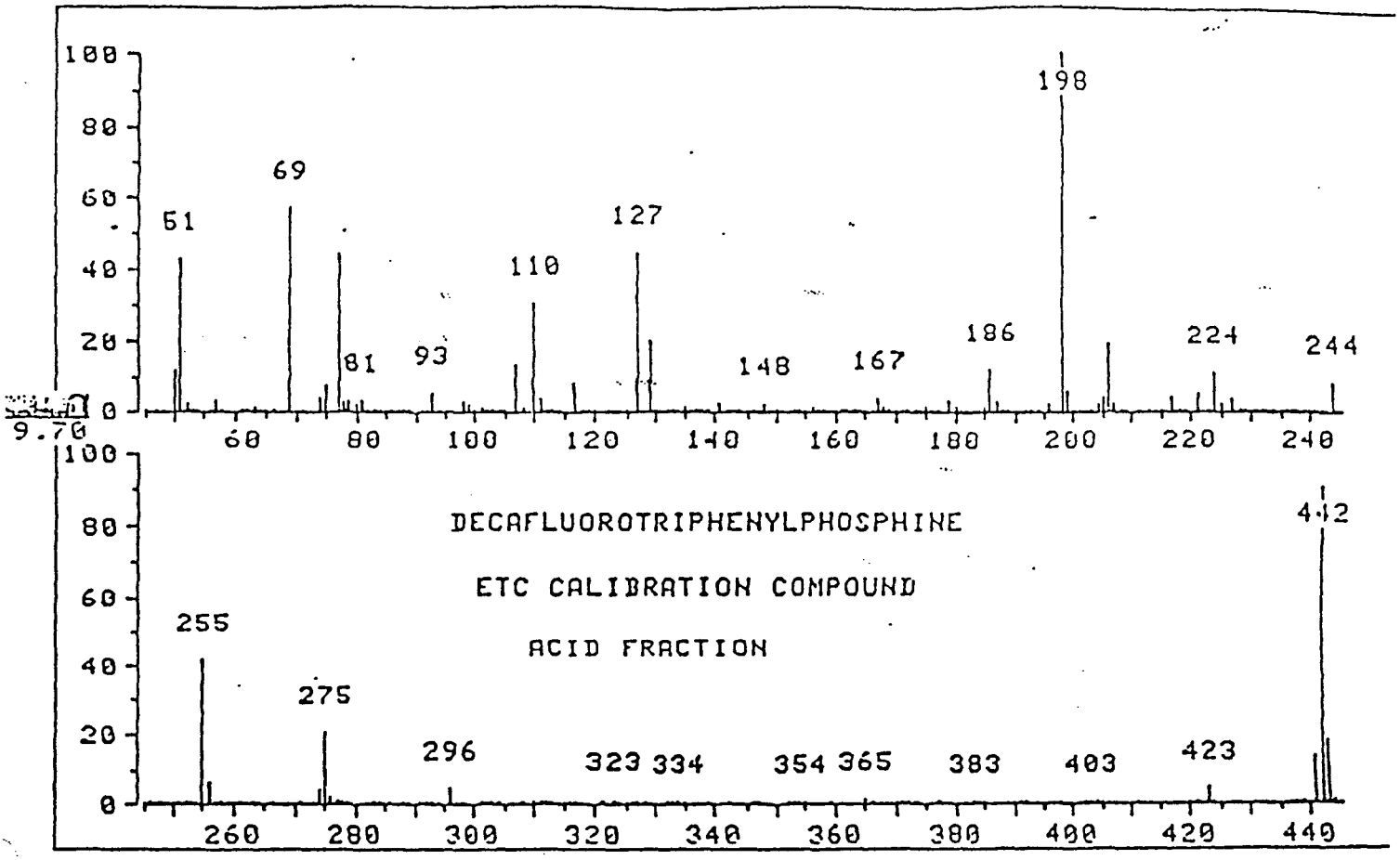
EPA CRITERION VERIFIER

7384
TRUM: 27

ass	Rel. Abund.	Criterion
0	29.0969	15-40% MASS 95
5	54.3313	30-60% MASS 95
5	100	BASE PEAK
6	6.875	5-9% MASS 95
73	0	<1% MASS 95
74	65.2531	>50% MASS 95
75	5.17813	5-9% MASS 174
76	62.8063	>50% MASS 95
77	4.80313	5-9% MASS 176

: '**' indicates out of range!

S <RETURN> TO RERUN...



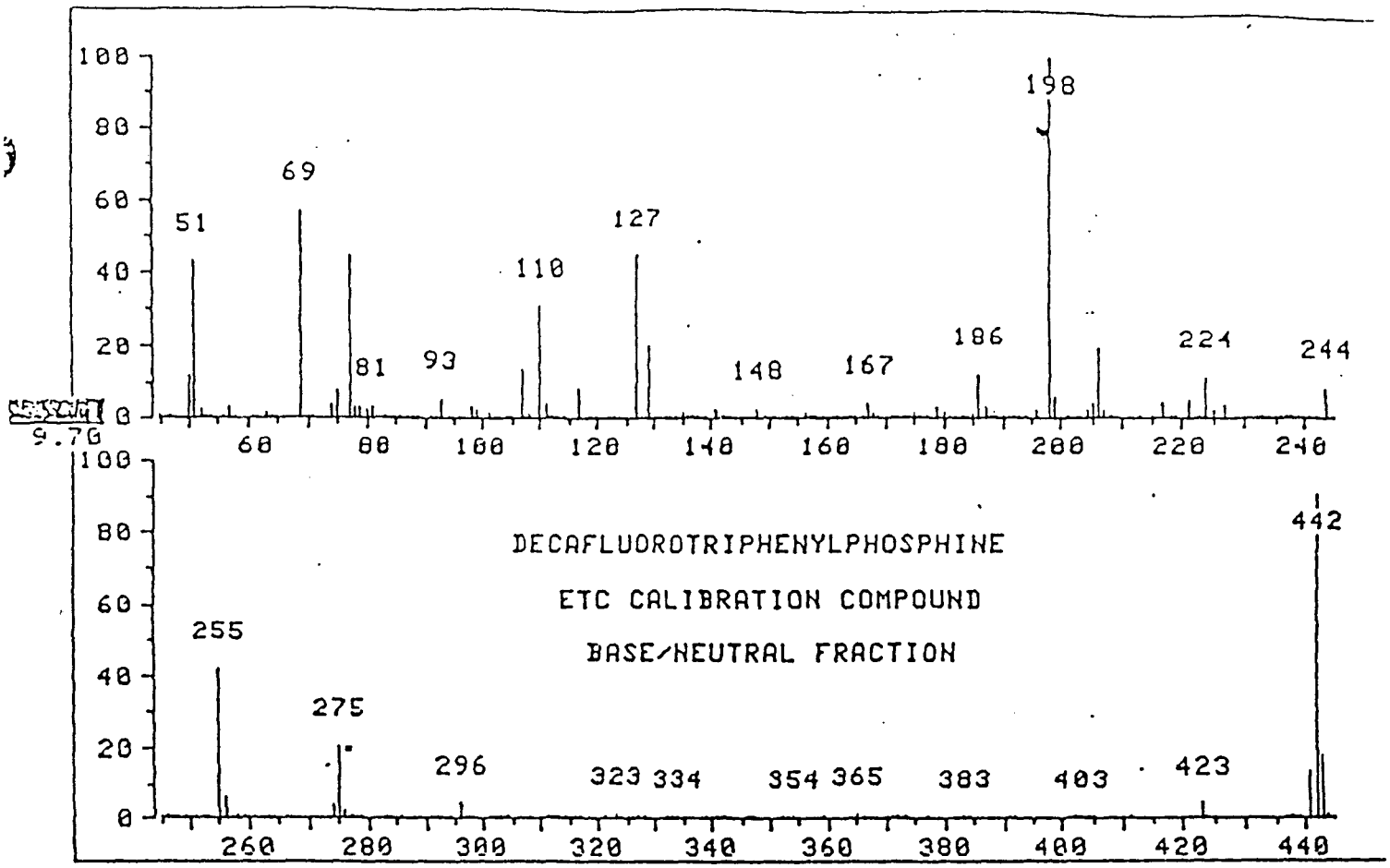
TPP EPA CRITERION VERIFIER

N: 6954
ECTRUM: 1

Mass	Rel. Abund.	Criterion
51	42.4656	30-60% MASS 198
68	0	< 2% MASS 69
69	57.05	
70	.121875	< 2% MASS 69
127	45.0844	40-60% MASS 198
197	0	< 1% MASS 198
198	100	BASE PEAK
199	6.24375	5-9% MASS 198
275	20.6688	10-30% MASS 198
365	2.09375	>. 1% MASS 198
441	14.2625	< MASS 443
442	90.6938	> 40% MASS 198
443	18.4938	17-23% MASS 442

ITE: '**' indicates out of range!

ESS <RETURN> TO RERUN...



FTPP EPA CRITERION VERIFIER

RN: 6954
PECTRUM: 1

Mass	Rel. Abund.	Criterion
51	42.4656	30-60% MASS 198
68	0	< 2% MASS 69
69	57.05	
70	.121875	< 2% MASS 69
127	45.8844	40-60% MASS 198
197	0	< 1% MASS 198
198	100	BASE PEAK
199	6.24375	5-9% MASS 198
275	20.6688	10-30% MASS 198
365	2.09375	> 1% MASS 198
441	14.2625	< MASS 443
442	90.6938	> 40% MASS 198
443	18.4938	17-23% MASS 442

TE: '**' indicates out of range!

ESS <RETURN> TO RERUN...

CHAIN OF CUSTODY FORM (CC1)

Seal Date: 7/20/83
Sealed By: Dannell

SHIP TO:

Company: J. Serrine Co
Facility/Site: 216 S. Pleasantburg Dr
Address: Greenville, SC 29606
Attn: Bill Baskin
Phone: ( ) -

SAMPLE IDENTIFICATION

Facility/Site Code: FI-1101013 | | |

Grab

Source Codes:

Well — (W)	River/Stream — (R)	Surface Impoundment — (I)	Lake/Ocean — (L)
Soil — (S)	Bottom Sediment — (B)	Pretreatment Facility — (P)	Treatment Facility — (T)
Outfall — (O)	Generation Point — (G)	Leachate Collection Sys. — (C)	Other — (X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	N1-12	018/018/83	1215	0010
Sample: W	1101/W12613P1	05/15/811	0913	10

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
7627 V_1 to V_2	✓		
7627 E_1 to E_2	✓		
7627 M_1	✓		
7627 TB ✓	✓		

CHAIN OF CUSTODY CHRONICLE

Shuttle Opened By: (print) W.T. Baskin Date: 8/1/83 Time: 9:15am
Signature: W T Baskin Seal #: 0022551 Intact:

I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

Shuttle Sealed By: (print) W. T. BASKIN Date: 8/9/83 Time: 1300
Signature: W T Baskin Seal #: 0022552

ETC USE ONLY Opened By: D Farnell Date: 8/10/83 Time: 10:20A
Seal #: 22552 Condition: Seal intact

CHAIN OF CUSTODY FORM (CC1)

Sealed By: G. Morrison

SHIP TO:

Company: J. Sevrine Co.
City/State: 216 S. Pleasantburg Dr.
Address: Greenville, SC 29606
Attn: Bill Baskin
Phone: ( ) -

SAMPLE IDENTIFICATION

Facility/Site Code: F1-1/1010/7

Grab

Source Codes:

Well — (W)	River/Stream — (R)	Surface Impoundment — (I)	Lake/Ocean — (L)
Soil — (S)	Bottom Sediment — (B)	Pretreatment Facility — (P)	Treatment Facility — (T)
Outfall — (O)	Generation Point — (G)	Leachate Collection Sys. — (C)	Other — (X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Dosed Hours (composite)
W	W1-121	018/2/2/8/3	1014/5	00d
Sample: W	1101/U2613P1	0/5/1/5/8/1	0913/0	131

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
7627 E1 to	E3		

CHAIN OF CUSTODY CHRONICLE

Shuttle Opened By: (print) W. T. Baskin Date: 8/18/83 Time: 11:35am

Signature: W T Baskin Seal #: 0021815 Intact: ✓

I have received these materials in good condition from the above person.

Name: Signature:

Date: Time: Remarks:

I have received these materials in good condition from the above person.

Name: Signature:

Date: Time: Remarks:

I have received these materials in good condition from the above person.

Name: Signature:

Date: Time: Remarks:

Shuttle Sealed By: (print) W. T. Baskin Date: 8/22/83 Time: 2:00pm

Signature: W T Baskin Seal #: 0021814

ETC USE ONLY Opened By: J. Ritter Date: 8/23/83 Time: 12:25

Seal #: 21814 Condition: Seal Intact

LABORATORY CHAIN-OF-CUSTODY

ETC Sample Number(s) C7627, C7628, C7629

Relinquished By D Farrell

Received By J. Bini Date 8/10/83 Time 7:00 P.M.

Relinquished By _____

Received By _____ Date _____ Time _____

Relinquished By _____

Received By _____ Date _____ Time _____

Relinquished By _____

Received By _____ Date _____ Time _____

Relinquished By _____

Received By _____ Date _____ Time _____

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number(s) C7627, C7628, C7629

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Rick Powell	8/11/83
Acids	Rick Powell	8/11/83
Metals	J. Bini	8/11/83
Others RP/Acg	Rick Powell	8/11/83
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kenth. Hsu	8/22/83
Acids	Kenth Hsu	8/22/83
VOA/Purgeables	Oland Krajoza	8/22/83
Metals	J. Bini	8/15/83
Others		
Others		
Others		
Others		
Others		
Others		

Verified By B.F. Stubenbordt

September 1, 1983

TECHNICAL REPORT

for

J. Serrine Company
P.O. Box 5456
216 S. Pleasantburg Dr.
Greenville, SC 29606

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7629	J. Serrine Company	SINGLENLF	WNE-1	830808	1015	

ENVIRONMENTAL TESTING and CERTIFICATION CORPORATION

Denis C. K. Lin, Ph.D.
Vice President
Research and Operations

INTRODUCTION

This report contains the analytical results on your water sample, WHE-1 830808 1015, submitted on August 10, 1983. It is designed to satisfy the needs of your people at various levels in your organization.

The results we obtained on your sample are presented in a tabular format immediately after this introduction. Included with the sample results, the quality assurance data on your specific sample are tabulated to verify the validity of the results obtained. The quality assurance data include those obtained on the surrogates, the blank, the spiked blank, the replicate and the spiked sample (commonly known as matrix spike). Also presented in the quality assurance data report is the verification of the proper functioning of the instruments used. The gas chromatograms and/or mass spectra generated in the analysis of your sample are included in the Appendix of the report. The chain of custody record for your sample is included at the end of this report.

The established methods we used in the analysis of your sample are described in the Methodology section after the Results. In the analysis we followed a rigidly controlled Quality Assurance Protocol. This Protocol is described after the Methodology section.

We hope our report format is useful in assisting you to obtain pertinent information on your sample.

RESULTS

The results obtained on your sample and the accompanying quality assurance data are listed in Table 1. The compounds of interest are listed with their NPDES (National Pollution Discharge Elimination System) number, and Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound is detected below its MDL it is reported in Table 1 as BMDL (Below Method Detection Limit). When a compound is searched for and cannot be found it is reported as ND (Not Detected). The quality assurance data include results obtained on the Method Blank, Spiked Blank, Replicate, and Matrix Spike analyses. However, since the Replicate and Matrix Spike analyses were performed on samples randomly chosen in a sample batch, your specific sample may not be the selected one.

The data on the recovery of the surrogates in your sample and the certification of the GC/MS systems used in the analysis of your sample are listed in Table 2.

The Chain-of-Custody Record on your sample is also included at the end of this Report.

August 30, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds – GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7629	J. SERRINE COMPANY	SINGLENLF	WNE-1	830808	1015	

PDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l*	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Concen. Added ug/l	QC Blank and Spiked Blank: % Recov.	QC Matrix Spike: Unspiked Sample ug/l	QC Matrix Spike: Concen. Added ug/l	QC Matrix Spike: % Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	85	ND	1600	74
2V	Acrylonitrile	ND	100	ND	ND	ND	160	84	ND	160	88
3V	Benzene	ND	10	ND	3	ND	36	89	ND	36	90
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	10	ND	ND	ND	36	100	ND	36	94
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	97	ND	36	104
7V	Chlorobenzene	ND	10	ND	2	ND	36	94	ND	36	103
8V	Chlorodibromomethane	ND	10	ND	ND	ND	36	101	ND	36	99
9V	Chloroethane	ND	10	ND	ND	ND	36	102	ND	36	106
0V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	105	ND	36	97
1V	Chloroform	ND	10	ND	ND	ND	36	96	ND	36	96
2V	Dichlorobromomethane	ND	10	ND	ND	ND	36	101	ND	36	93
3V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
4V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	86	ND	36	87
5V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	91	ND	36	88
6V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	86	ND	36	88
7V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	79	ND	36	79
8V	1,3-Dichloropropylene	ND	10	ND	ND	ND	36	73	ND	36	81
9V	Ethylbenzene	ND	10	ND	ND	ND	36	96	ND	36	96
0V	Methyl bromide	ND	10	ND	ND	ND	36	102	ND	36	102
V	Methyl chloride	ND	10	ND	ND	ND	36	90	ND	36	103
2V	Methylene chloride	16	10	ND	ND	BMDL	36	78	9	36	42
4V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	92	ND	36	86
V	Tetrachloroethylene	ND	10	ND	ND	ND	36	99	ND	36	103
V	Toluene	ND	10	ND	ND	ND	36	92	2	36	87
V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	88	ND	36	81
V	1,1,1-Trichloroethane	ND	10	4	4	ND	36	97	ND	36	100
V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	98	ND	36	91
V	Trichloroethylene	ND	10	ND	ND	ND	36	92	ND	36	94
V	Trichlorofluoromethane	ND	10	ND	ND	ND	36	96	18	36	51
V	Vinyl chloride	ND	10	ND	ND	ND	36	97	ND	36	103

*EPA published Method Detection Limit

August 26, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds - GC/MS Analysis Data (QR02)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7629	J. SERRINE COMPANY	SINGLENLF	WNE-1	830808	1015	

NPDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Amount Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Extract ug/l	QC Matrix Spike: Amount Added ug/l	QC Matrix Spike: % Recov
1A	2-Chlorophenol	ND	25	ND	ND	ND	150	91	ND	153	66
2A	2,4-Dichlorophenol	ND	25	ND	ND	ND	150	93	ND	153	78
3A	2,4-Dimethylphenol	ND	25	ND	ND	ND	150	60	ND	153	41
4A	4,6-Dinitro-o-cresol	ND	250	ND	ND	ND	250	79	ND	255	80
5A	2,4-Dinitrophenol	ND	250	ND	ND	ND	250	64	ND	255	79
6A	2-Nitrophenol	ND	25	ND	ND	ND	150	91	ND	153	78
7A	4-Nitrophenol	ND	25	ND	ND	ND	150	59	ND	153	46
8A	p-Chloro-m-cresol	ND	25	ND	ND	ND	150	85	ND	153	68
9A	Pentachlorophenol	ND	25	ND	ND	ND	150	98	ND	153	79
10A	Phenol	ND	25	ND	ND	ND	150	38	ND	153	28
11A	2,4,6-Trichlorophenol	ND	25	ND	ND	ND	150	100	ND	153	80

* EPA published Method Detection Limit

Sep... 3, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Base/Neutral Compounds – GC/MS Analysis Data (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7629	J. SERRINE COMPANY	SINGLENLF	WNE-1	830808	1015	

NPDES Number	Compound	Results: Sample Concen ug/l	Results: * MDL ug/l	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Amount Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Extract ug/l	QC Matrix Spike: Amount Added ug/l	QC Matrix Spike: % Recov
18	Acenaphthene	ND	10	ND	ND	ND	100	96	ND	102	91
28	Acenaphthylene	ND	10	ND	ND	ND	100	89	ND	102	87
38	Anthracene	ND	10	ND	ND	ND	100	87	ND	102	90
48	Benzidine	ND	10	ND	ND	ND	100	20**	ND	102	21**
58	Benzo(a)anthracene	ND	10	ND	ND	ND	100	84	ND	102	61
68	Benzo(a)pyrene	ND	10	ND	ND	ND	100	44**	ND	102	37**
78	Benzo(b)fluoranthene	ND	10	ND	ND	ND	100	36	ND	102	27
88	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
98	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	43	ND	102	36
08	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	103	ND	102	105
18	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	96	ND	102	99
28	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	61	ND	102	108
38	bis(2-Ethylhexyl)phthalate	ND	10	17	60	ND	100	80	ND	102	58
48	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	105	ND	102	93
58	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	91	ND	102	97
68	2-Chloronaphthalene	ND	10	ND	ND	ND	100	75	ND	102	84
78	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	143	ND	102	122
88	Chrysene	ND	10	ND	ND	ND	100	94	ND	102	74
98	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
08	1,2-Dichlorobenzene	ND	10	ND	6	ND	100	7**	ND	102	75
18	1,3-Dichlorobenzene	ND	10	ND	6	ND	100	5**	ND	102	72
28	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	4**	ND	102	52
38	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	36**	ND	102	27**
48	Diethyl phthalate	ND	10	ND	ND	ND	100	50	ND	102	56
58	Dimethyl phthalate	ND	10	ND	ND	ND	100	3**	ND	102	6**
68	Di-n-butyl phthalate	ND	10	ND	ND	ND	100	124**	ND	102	112**
78	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	99	ND	102	84
88	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	102	ND	102	89
98	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	92	ND	102	71
08	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	113	ND	102	96
18	Fluoranthene	ND	10	ND	ND	ND	100	100	ND	102	79

EPA Published Method Detection Limit.

* Recoveries normally low & variable using EPA Protocol Method 625.

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Base/Neutral Compounds – GC/MS Analysis Data (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7629	J. SERRINE COMPANY	SINGLENLF	WNE-1	830808	1015	

DES nber	Compound	Results		QC Replicate		QC Blank and Spiked Blank			QC Matrix Spike		
		Sample Concen. ug/l	* MDL ug/l	First ug/l	Second ug/l	Blank Data ug/l	Amount Added ug/l	% Recov	Unspiked Extract ug/l	Amount Added ug/l	% Recov
3	Fluorene	ND	10	ND	ND	ND	100	108	ND	102	92
3	Hexachlorobenzene	ND	10	ND	ND	ND	100	92	ND	102	82
3	Hexachlorobutadiene	ND	10	ND	ND	ND	100	3	ND	102	65
3	Hexachlorocyclopentadiene	ND	10	ND	ND	ND	0	-	ND	0	-
3	Hexachloroethane	ND	10	ND	ND	ND	100	0	ND	102	50
3	Indeno(1,2,3-c,d)pyrene	ND	10	ND	ND	ND	0	-	ND	0	-
3	Isophorone	ND	10	ND	ND	ND	100	69	ND	102	71
3	Naphthalene	ND	10	ND	ND	ND	100	23	ND	102	71
3	Nitrobenzene	ND	10	ND	ND	ND	100	75	ND	102	87
3	N-Nitrosodimethylamine	ND	10	ND	ND	ND	0	-	ND	0	-
3	N-Nitrosodi-n-propylamine	ND	10	ND	ND	ND	100	65	ND	102	65
3	N-Nitrosodiphenylamine	ND	10	ND	ND	ND	100	98	ND	102	84
3	Phenanthrene	ND	10	ND	ND	ND	100	138	ND	102	112
3	Pyrene	ND	10	ND	ND	ND	100	85	ND	102	74
3	1,2,4-Trichlorobenzene	ND	10	ND	3	ND	100	63	ND	102	86
	2,3,7,8-TCDD	ND	10	ND	ND	ND	0	-	ND	0	-

EPA Published Method Detection Limit.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

August 30, 1983

TABLE 1: QUANTITATIVE RESULTS

Metals, Cyanide and Phenols – Analysis Data (QR05)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7629	J. SERRINE COMPANY	SINGLENLF	WNE-1	830808	1015	

NPDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l
1M	Antimony	ND	200
2M	Arsenic	ND	200
3M	Beryllium	ND	6
4M	Cadmium	ND	20
5M	Chromium	BMDL	30
6M	Copper	BMDL	10
7M	Lead	ND	100
8M	Mercury	BMDL	0.3
9M	Nickel	ND	20
10M	Selenium	BMDL	200
11M	Silver	ND	20
12M	Thallium	-	-
13M	Zinc	180	9
14M	Cyanide, Total	-	-
15M	Phenolics, Total	-	-
	Aluminum	BMDL	100
	Boron	ND	40
	Barium	10	6
	Calcium	17000	1000
	Cobalt	ND	60
	Iron	BMDL	200
	Magnesium	4000	1000
	Manganese	230	7
	Molybdenum	BMDL	40
	Sodium	7000	1000
	Tin	ND	200
	Titanium	ND	7
	Vanadium	BMDL	9

August 30, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Bromofluorobenzene (BFB) for Volatiles Analysis (QR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7629

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of the base peak	29
75	30-60% of the base peak	54
95	Base Peak, 100% relative abundance	100
96	5-9% of the base peak	7
173	Less than 1% of the base peak	<1
174	Greater than 50% of the base peak	65
175	5-9% of mass 174	5
176	Greater than 50% of the base peak	63
177	5-9% of mass 176	5

Date: 082283
Run No: 7384
Spectrum No: 27
Analyst: P. Krajczar

September 3, 1983

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery – GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7629

ETC Sample No. | Company | Facility | Sample Point | Date | Time | Elapsed Hours

Compound	Amount Added ug	% Recovery	Control Limits * Lower	Control Limits * Upper
VOLATILE FRACTION				
Bromochloromethane	.200	107	79	127
Benzene, d_6	.150	105	63	122
Fluorobenzene	.150	110	74	122
1,4-Dichlorobutane	.200	97	75	117
Pentafluorobenzene	.150	129**	56	124
Ethylbenzene, d_{10}	.150	113	78	114
ACID FRACTION				
2-Fluorophenol	80	40	20	86
Pentafluorophenol	80	43	37	127
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	78	62	122
1-Fluoronaphthalene	80	64	64	104
Nitrobenzene, d_5	80	78	58	105

* Three Standard Deviations About the Mean.

** Recovery affected by sample matrix interference.

August 26, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7629

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	31
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	51
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	5
275	10-30% of mass 198	20
365	Greater than 1% of mass 198	2
441	Less than mass 443	7
442	Greater than 40% of mass 198	51
443	17-23% of mass 442	9

Date: 082183
Run No.: 21591
Spectrum No.: 243
Analyst: K. R. Weiner

September 3, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Base/Neutrals Analysis (QR23)

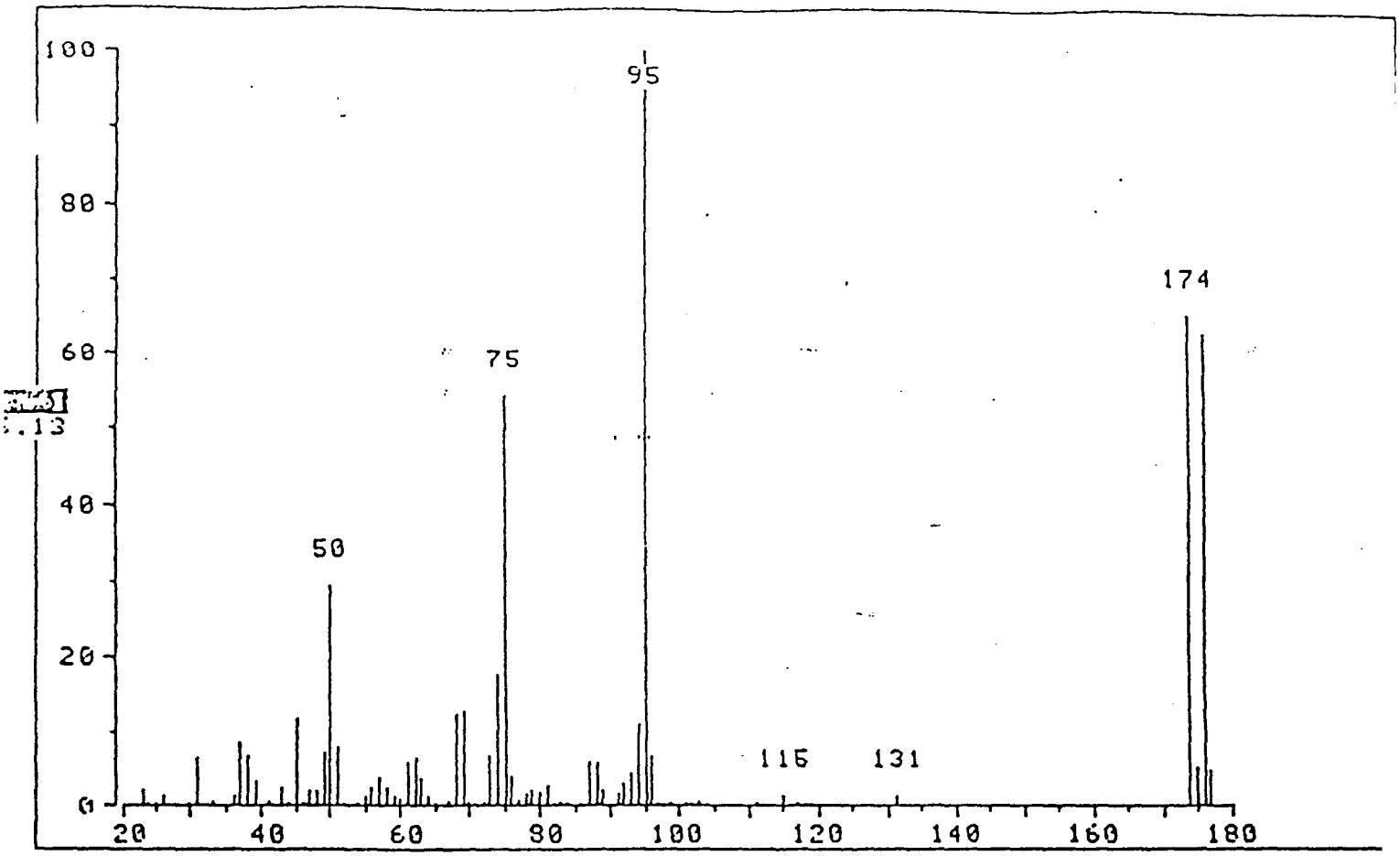
Chain of Custody Data Required for ETC Data Management Summary Reports

C7629

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	60
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	48
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	22
365	Greater than 1% of mass 198	2
441	Less than mass 443	14
442	Greater than 40% of mass 198	95
443	17-23% of mass 442	19

Date: 082183
Run No: 25754
Spectrum No: 112
Analyst: K. Welner



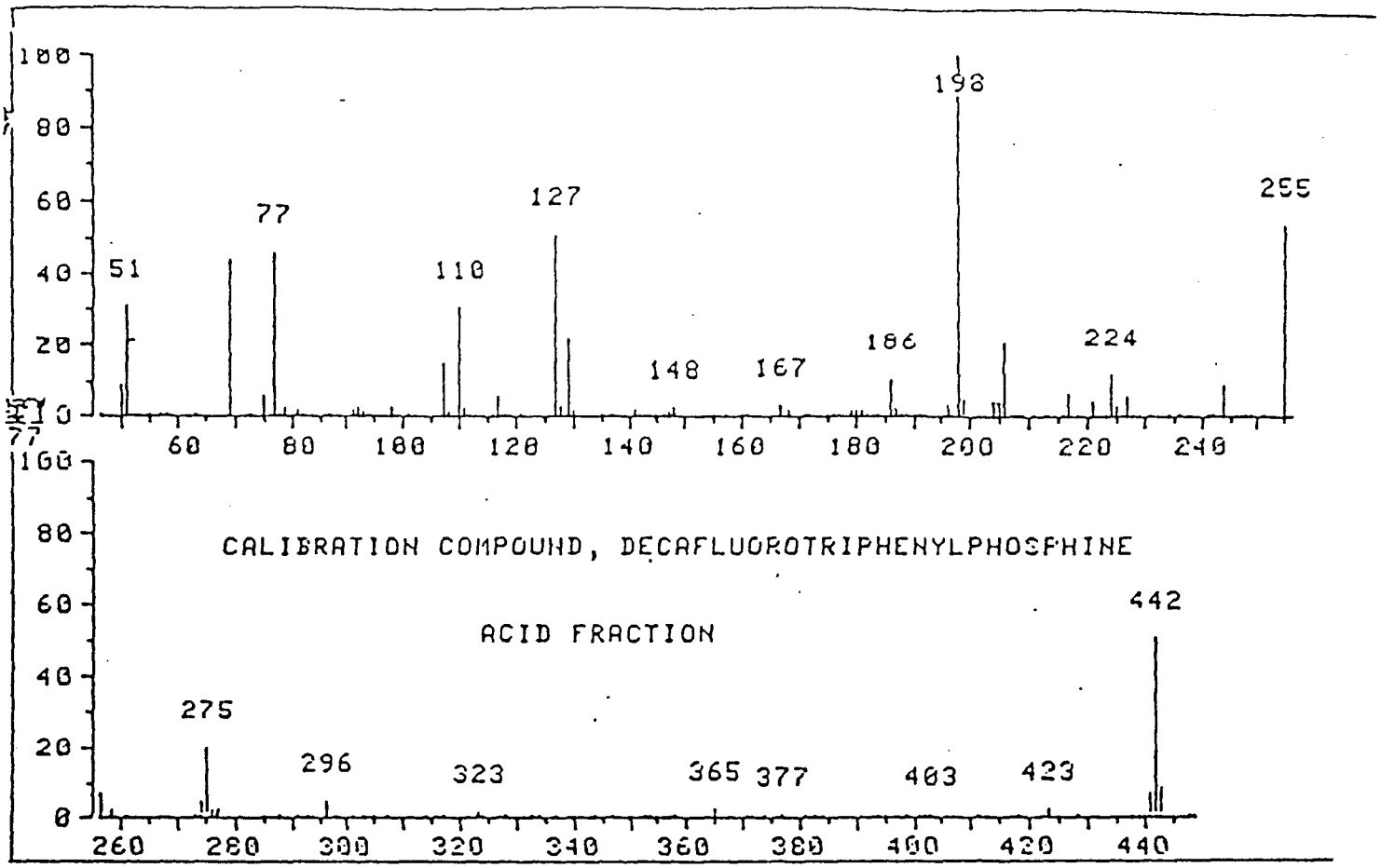
FB EPA CRITERION VERIFIER

: 7384
CTRUM: 27

Mass	Rel. Abund.	Criterion
50	29.0969	15-40% MASS 95
75	54.3313	30-60% MASS 95
95	100	BASE PEAK
96	6.875	5-9% MASS 95
173	0	<1% MASS 95
174	65.2531	>50% MASS 95
175	5.17813	5-9% MASS 174
176	62.8063	>50% MASS 95
177	4.80313	5-9% MASS 176

: '**' indicates out of range!

SS <RETURN> TO RERUN...



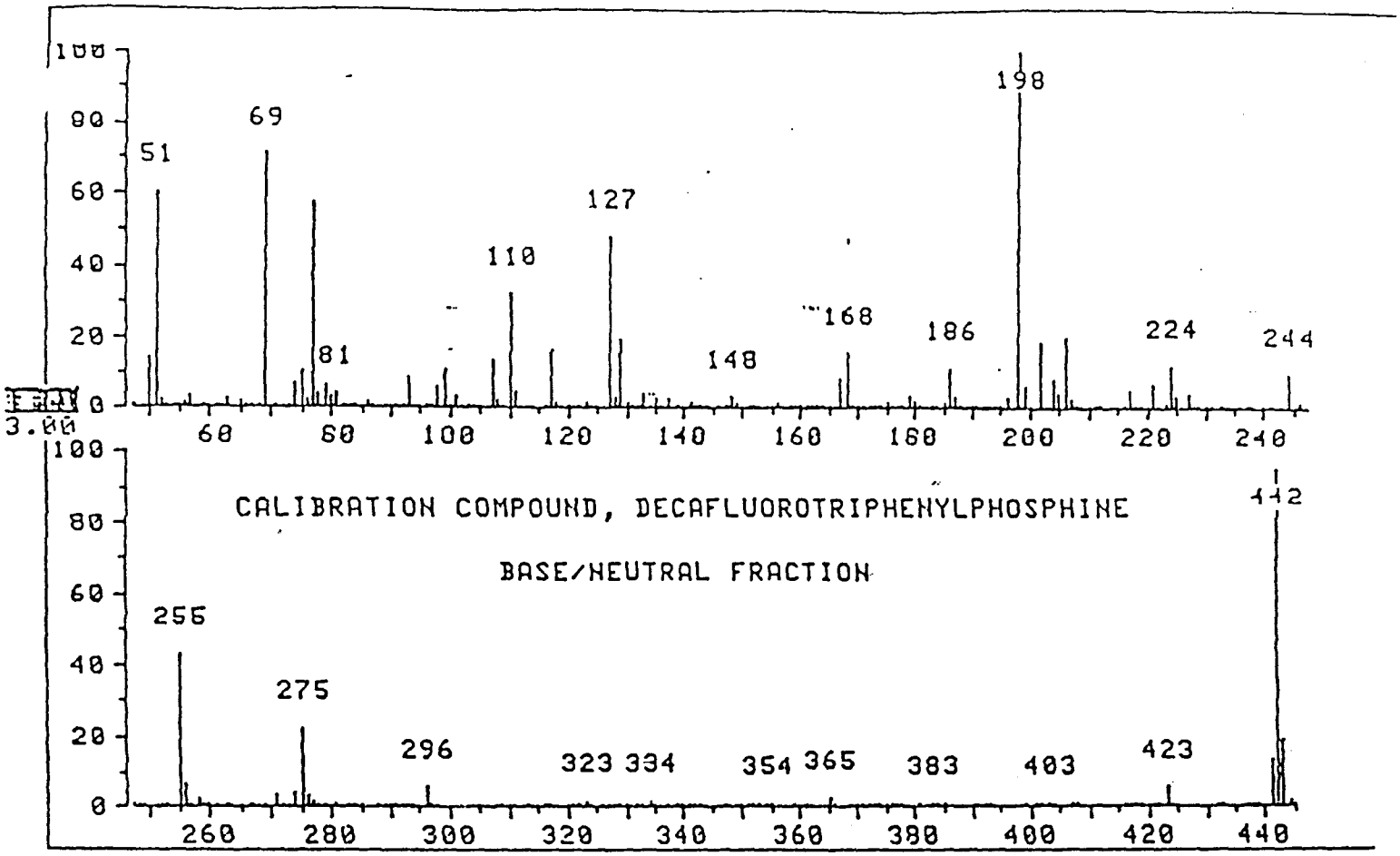
EPA CRITERION VERIFIER

21592
RUM: 1

ss	Rel. Abund.	Criterion
	30.8344	30-60% MASS 198
	0	< 2% MASS 69
	43.6594	
	0	< 2% MASS 69
7	50.575	40-60% MASS 198
7	0	< 1% MASS 198
8	100	BASE PEAK
9	5.33125	5-9% MASS 198
5	19.7406	10-30% MASS 198
5	2.45	> 1% MASS 198
1	6.91562	< MASS 443
2	50.8656	> 40% MASS 198
3	8.93438	17-23% MASS 442

'**' indicates out of range!

<RETURN> TO RERUN...



PP EPA CRITERION VERIFIER

I: 25755
CTRUM: 1

Mass	Rel. Abund.	Criterion
51	59.9313	30-60% MASS 198
68	1.405	< 2% MASS 69
69	70.5094	
70	.203125	< 2% MASS 69
127	47.525	40-60% MASS 198
197	0	< 1% MASS 198
198	100	BASE PEAK
199	6.37187	5-9% MASS 198
275	22.1031	10-30% MASS 198
365	2.30625	> 1% MASS 198
441	13.6281	< MASS 443
442	95.2531	> 40% MASS 198
443	19.1875	17-23% MASS 442

E: '**' indicates out of range!

CHAIN OF CUSTODY FORM (CC1)

Seal Date: 11-20-83
Sealed By: Dennell

SHIP TO:

Company: T SERRINE Co
City/Site: 216 S. Pleasantburg Dr
Address: Greenville SC 29606
Attn: Bill Baskin
Phone: ( ) -

SAMPLE IDENTIFICATION.

Facility/Site Code: F1-1101013

Grab Sample

Source Codes:

Well — (M)	River/Stream — (R)	Surface Impoundment — (I)	Lake/Ocean — (L)
Soil — (S)	Bottom Sediment — (B)	Pretreatment Facility — (P)	Treatment Facility — (T)
Outfall — (O)	Generation Point — (G)	Leachate Collection Sys. — (C)	Other — (X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	W1-12	08/08/83	1210	000
Example: W	1101/U2613P1	05/15/81	0930	13

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
C7628 V1 to V2 ✓			
C7628 E1 to E2 only rec'd E2			
C7628 M1 ✓	V1 rec'd w/ headspace		

CHAIN OF CUSTODY CHRONICLE

1. Shuttle Opened By: (print) W. T. Baskin Date: 8/1/83 Time: 9:15 am
Signature: W T Baskin Seal #: 0022551 Intact:

2. I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

3. I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

4. I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

5. Shuttle Sealed By: (print) W. T. BASKIN Date: 8/9/83 Time: 1300
Signature: W T Baskin Seal #: 0022552

CTC USE ONLY Opened By: D Farrell Date: 8/10/83 Time: 10:30A
Seal #: 22552 Condition: Seal intact

LABORATORY CHAIN-OF-CUSTODY

ETC Sample Number(s) C7627, C7628, C7629

Relinquished By D Farrell

Received By J. Bini Date 8/10/83 Time 7:00 P.M.

Relinquished By

Received By Date Time

Relinquished By

Received By Date Time

Relinquished By

Received By Date Time

Relinquished By

Received By Date Time

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

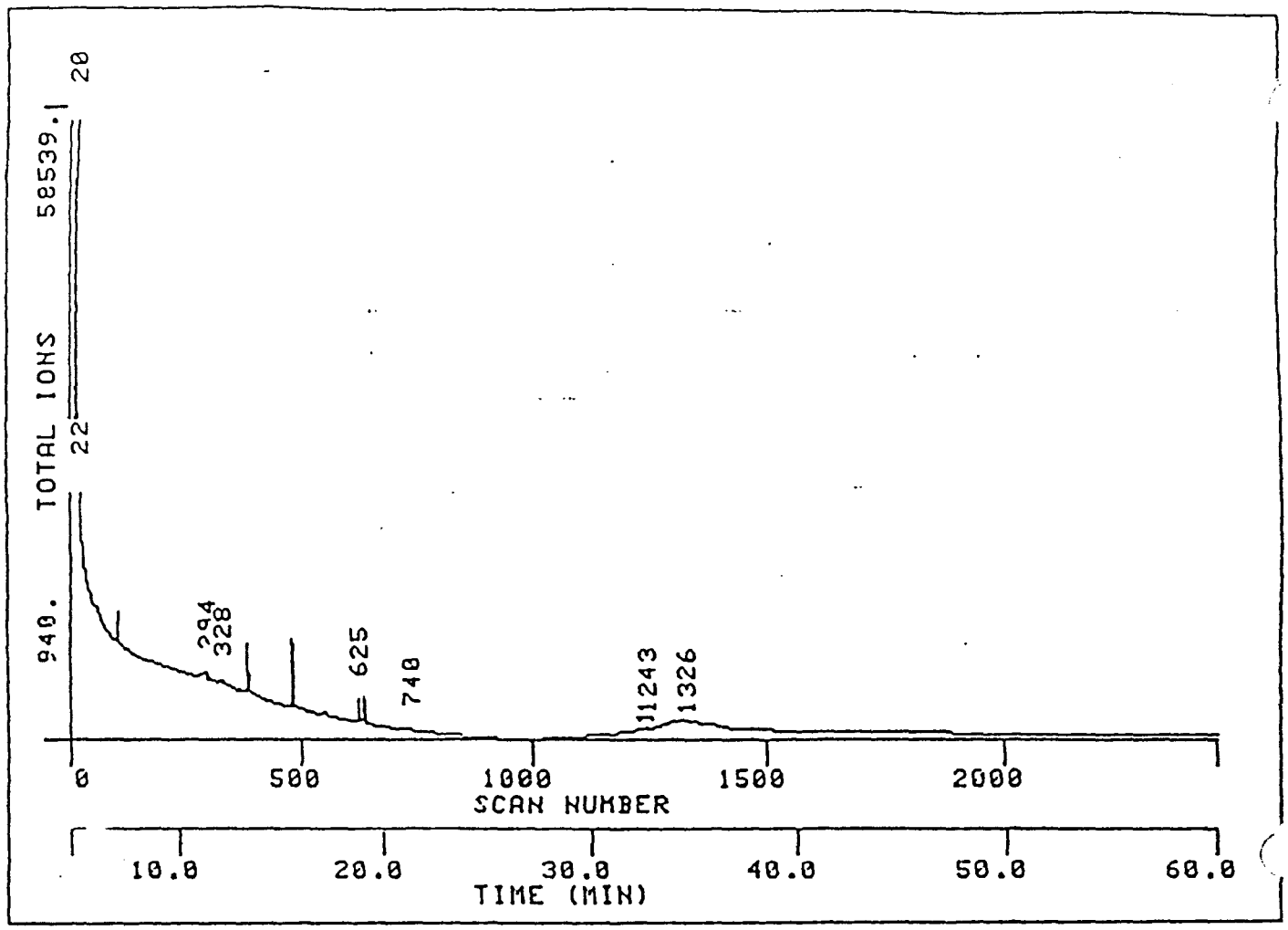
ETC Sample Number(s) C7627, C7628, C7629

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	[illegible]	8/11/83
Acids	[illegible]	8/11/83
Metals	J. Bini	8/11/83
Others RP/Org	[illegible]	8/11/83
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kent R. Hill	8/22/83
Acids	Kent R. Hill	8/22/83
VOA/Purgeables	Oleard Krajozer	8/22/83
Metals	J. Bini	8/15/83
Others		
Others		
Others		
Others		
Others		
Others		

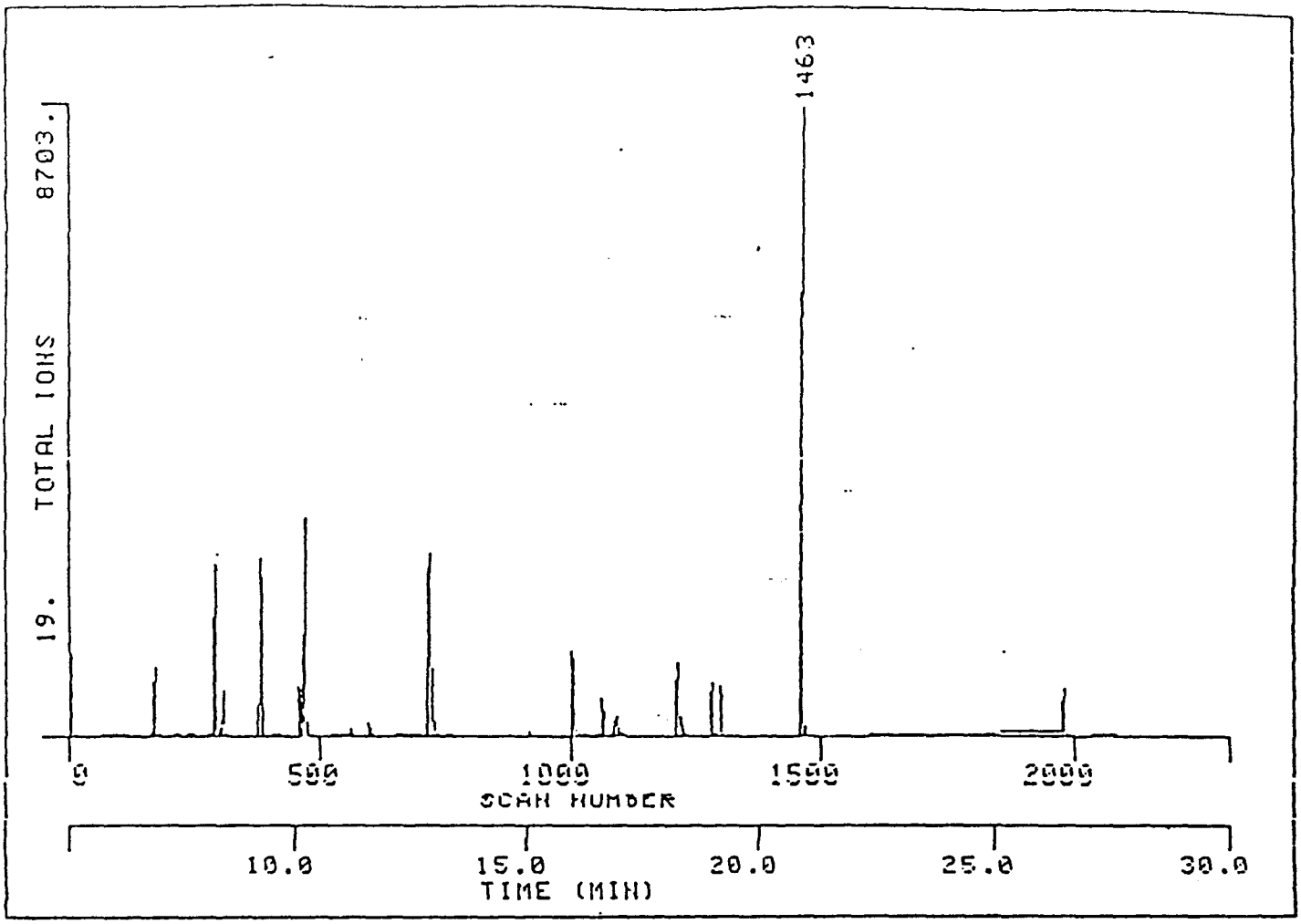
Verified By [illegible]

TOTAL ION CHROMATOGRAM



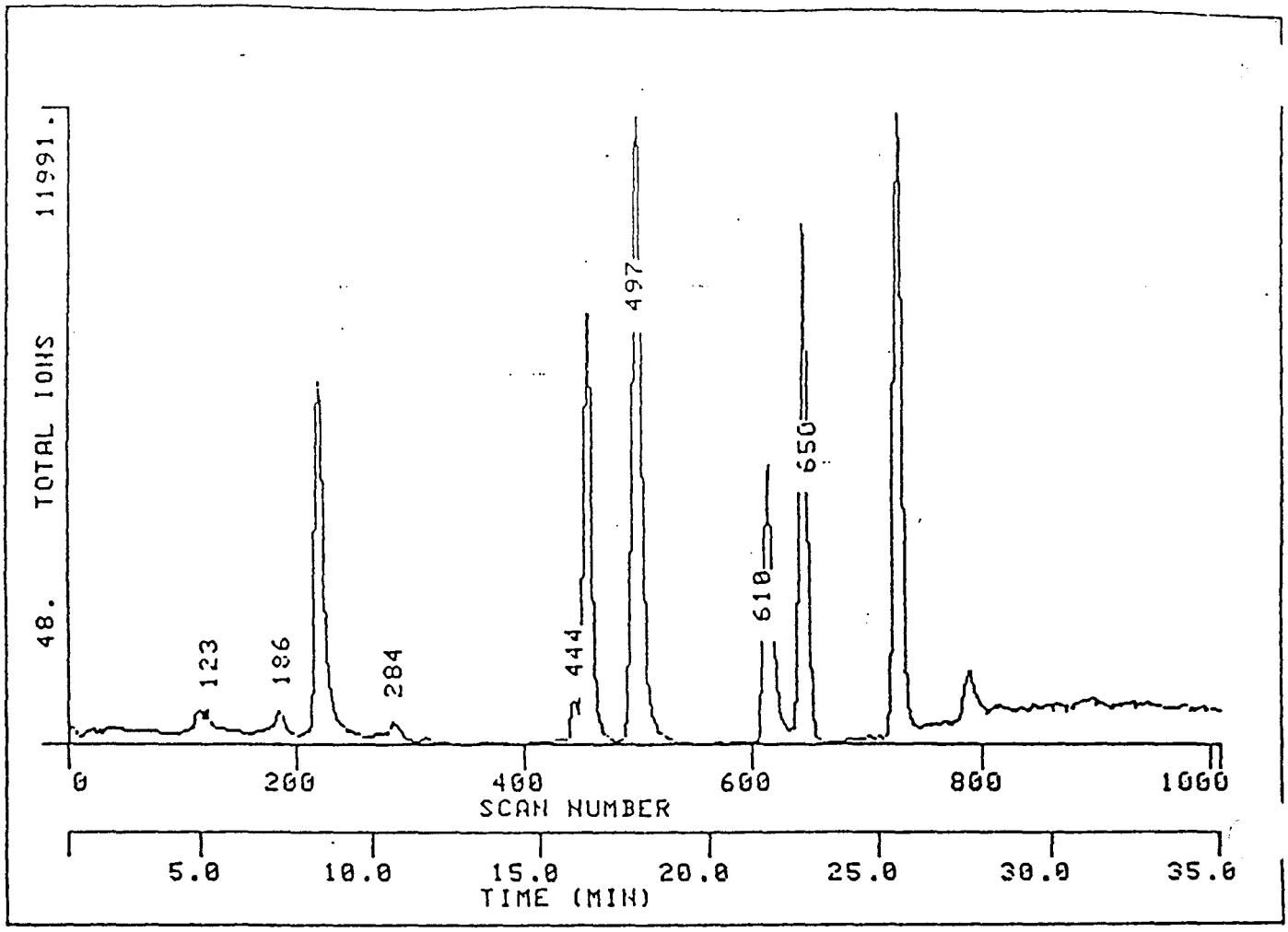
MS Data File FRN: 25770
Name: C7628 BASE/NEUTRAL FRACTION 830822, ER
Misc Data: C7628B BTL#15 D25770
Last R.T.: 60.0 minutes

TOTAL ION CHROMATOGRAM



MS Data File FRN: 21610
Name: C7628 ACID FRACTION 830821, I
Misc Data: C7628A BTL#18 D21610
Last R.T.: 30.0 minutes

TOTAL ION CHROMATOGRAM



MS Data File FRN: 7395
Name: C7628V, PURGEABLES FRACTION, 830822, A
Misc Data: C7628V BTL#7 D7395
Last R.T.: 35.0 minutes

- Absorbance of full scale standards must be within +/- 25% of nominal absorbance.

- Duplicate calibration standards at four different concentrations are run with each batch of customer samples.

- At least one intersample standard is run for each 20 customer samples.

- Gain and carryover standards are analyzed at the end of each run.

Analysis of 2,3,7,8-TCDD (Dioxin)

A routine GC/MS scan for 2,3,7,8-TCDD (Dioxin) using Method 625 has a detection limit of approximately 10 ppb in a water matrix and 330 ppb in other matrices. The highly toxic nature of this compound may require analysis to one part per billion or lower. To reach this level of detection requires added safety precautions for laboratory personnel, dedication of a laboratory to such analyses, and special QA/QC techniques.

ETC has installed a high hazard laboratory adjacent to its main building for analysis of dioxin and other high hazard materials. The extraction techniques are rigorous. Analyses are based on Selected Ion Monitoring (SIM) and show dioxin concentrations as low as 0.1 ppb in water and 1 ppb in soils or sediments. SIM is essential to accurate quantitation of 2,3,7,8-TCDD since there are 21 other isomers with the same mass.

The QA/QC program consists of analyzing:

- each sample after spiking with a stable labeled radioactive (Carbon-13) analog of TCDD;

- a clean sample spiked with "native" TCDD supplied by the U.S. EPA Las Vegas laboratory;

- a replicate sample;

- a replicate sample that has been prepared using a Soxhlet extraction; and

- a method blank.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;

- outgoing shipping manifests;

- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;

- incoming shipping manifests;

- breaking the Shuttle's reseal;

- storing each labeled sample bottle in a secured area;

- disposition of each sample to an analyst or technician; and

- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 65% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 4 Replicates;
- 4 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 20 or less. Our QC program is a minimum of 66% and consists of analyzing:

- each of the 20 customer samples in duplicate;
- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Blanks.

Analysis of Pesticides, Herbicides and PCB's (EPA Method 608)

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 blank sample;
- 1 spiked blank sample;
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 blank QC sample for at least each 100 samples analyzed.

The GC instruments are tuned daily to meet performance criteria in Method 608. Because Method 608 lacks data acceptance criteria, ETC has developed its own upper and lower quality control limits. When a test result falls outside the control limits, the test is re-run.

Analysis of Cyanides and Phenols

Cyanides and phenols are analyzed using a Technicon AutoAnalyzer II GT.

- Each GC/MS is checked and retuned, if necessary, every eight hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.

- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using 2,2'-difluorobiphenyl as an internal standard.

- The calibration curve is verified with a mixture of priority pollutant standards every eight hours.

- Results are compared to the acceptance criteria given in Method 625; any that do not meet the criteria are re-analyzed.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.

- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.

- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S. EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any results with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.

- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).

- All calibration standards are analyzed in duplicate, at a minimum.

- Independent reference standards are used to check the accuracy of calibration standards.

- A check standard is analyzed every ten samples to validate the normal calibration curve.

Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 42% and consists of analyzing:

- 3 Replicates;

- 2 Replicate spikes;

- 2 Replicate independent reference standards;

- 8 Calibration standards (processed using the sample preparation method);

- 2 Blanks (processed using the sample preparation method);

- 4 Calibration standards (without sample preparation); and

- 1 Blank (without sample preparation).

Heterogeneous Samples (except for Mercury analysis)

Quality Assurance/Quality Control Proceedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
- National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;
- the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559); and
- "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980.

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we use to analyze priority pollutants.

Analysis of Volatile Organic Compounds (EPA Method 624)

- Each batch of 13 samples consists of 9 customer samples (at maximum), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.
- Three surrogate compounds are added to each sample in the batch of 13.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.
- Each GC/MS is checked and retuned, if necessary, every 8 hours to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.
- The calibration curve is verified with a mixture of priority pollutant standards every 8 hours.
- Results are compared to the acceptance criteria given in Method 624; any that do not meet the criteria are re-analyzed.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions (EPA Method 625)

- Each batch of 20 samples consists of 16 customer samples (at maximum), one blank sample, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.
- Five surrogate compounds are added to each sample in the batch of 20.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

REPORT APPENDICES

The following appendices provide the support analytical data associated with your sample analyses. They are arranged as follows:

Appendix A

1) Reconstructed total ion chromatogram of GC/MS analyses of your sample.

2) The individual mass spectra of all priority pollutant compounds which have been identified as being present in your sample.

3) The individual mass spectra of the corresponding compounds as obtained from the standards.

Appendix B

1) The mass spectra of the calibration compounds, 4-bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), as obtained on the date of sample analyses.

Appendix C [for plus 10 and 50% internal standard option]

1) Spectra of tentatively identified compounds, with their differences.

Appendix D

1) Subcontractor's report.

These data are provided to present a complete report on your sample and to provide the data on which analytical decisions have been based. We hope this will aid you in your own analysis of the data.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person(s) breaking the seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;
- disposition of each sample to an analyst or technician and;
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody;
- the time and date each person accepted or relinquished custody.

Analysis of Metals (Sample, for all metals except Mercury)

For all homogeneous samples (minimum of 42% QC), each sample batch may include up to 30 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

For all heterogeneous samples (minimum of 65% QC), every field sample in a sample batch is run in duplicate. A sample batch may include up to 30 samples and the following fixed number of QC samples:

- 4 Replicates.
- 4 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

Analysis of Metals (Sample, Mercury)

For every matrix (minimum of 66% QC), all the field samples in each sample batch are run in duplicate. A sample batch may include up to 20 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 10 Calibration standards (processed using the sample preparation method).
- 2 Blanks.

Analysis of Metals (Standards)

- New working standards are prepared for each batch of samples.
- Normal calibration is performed using a blank and four standards that have been carried through the entire sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis in the standard additions technique, a three point calibration is performed using U. S. EPA Methods for Chemical Analysis of Water and Wastes, 1979. Results are obtained using linear regression analysis. Any results obtained with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- Normal calibration curves are constructed using greater than or equal to 5 times the Instrumental Detection Limit (IDL) as the lowest concentration level.
- All calibration standards are analyzed in duplicate, as a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to establish the validity of the normal calibration curve.

ANALYSIS OF METALS

AQUEOUS

The determination of metals in aqueous samples was performed according to the methods published by EPA in "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March, 1979, and Appendix IV of the Federal Register, December 3, 1979. Arsenic, selenium and thallium were determined by furnace AA; silver, aluminum, barium, beryllium, boron, cadmium, calcium, chromium, copper, cobalt, iron, magnesium, manganese, molybdenum, nickel, lead, sodium, antimony, tin, titanium, vanadium, and zinc were determined by ICP emission spectrometry, except where lower levels of detection were required: in these cases (e.g. lead in groundwater monitoring samples) furnace AA was used. The determination of mercury was performed by cold vapor AA.

EP TOXICITY

The determination of metals in aqueous EP Toxicity leachates was performed according to the methods published by EPA in "Test Methods for Evaluating Solid Waste" EPA SW-846, July 1982, and Appendix IV of the Fed. Reg., Dec. 3, 1979. Silver, arsenic, barium, cadmium, chromium, lead and selenium were determined by ICP emission spectrometry. Mercury was determined using cold vapor AA. For leachates that are organic in nature, the analyses were performed according to the methods described under "OIL/SLUDGE," below.

SOIL/SEDIMENT

The determination of silver, beryllium, cadmium, chromium, copper, nickel, antimony, lead, and zinc in sediment samples was performed according to methods published by EPA in "Interim Methods for the Sampling and Analysis of Priority Pollutants in Sediments and Fish Tissue", EPA 600/4-81-055, October 1980. Mercury was determined according to the sediment method published by EPA in "Method for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, March 1979. Arsenic, selenium and thallium were determined by furnace AA using nitric acid in a closed decomposition vessel for sample digestion.

OIL/SLUDGE

The determination of silver, aluminum, boron, barium, beryllium, calcium, cadmium, copper, chromium, cobalt, iron, magnesium, manganese, molybdenum, sodium, nickel, lead, antimony, tin, titanium, vanadium, and zinc in sludge/petroleum-based samples was performed by ICP emission spectrometry using a magnesium nitrate dry ashing digestion technique.

Arsenic, selenium and thallium were determined by furnace AA using nitric acid in a closed decomposition vessel for sample digestion. Mercury was determined by cold vapor AA using the same digestion technique.

QUALITY ASSURANCE PROTOCOL

The quality assurance protocol followed in the analysis of your sample is based on the "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March, 1979; National Enforcement Investigation Center Policies and Procedures manual; EPA-330/9/79/001-R, October, 1979; and the recommended guidelines for EPA Method 624 and 625.

Our protocol calls for a higher percentage of quality assurance samples than the requirements of Method 624 and 625. The key QA elements for the analysis of priority pollutants are summarized as follows:

Method 624

- In every block of 10 samples, analysis of 7 field samples, one blank, one spiked sample and one replicate are performed. This amounts to a 30% quality control factor.
- A minimum of three surrogate compounds are added to each sample in the block of ten.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- The GC/MS is checked and retuned, if necessary, every eight hours to ensure its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a minimum of 3 concentrations of a standard mixture of the priority pollutants of interest and 3 internal standards (at a constant concentration).
- The calibration curve is verified with a standard priority pollutant mixture every eight hours.
- Results meet the acceptance criteria given in Method 624.

Method 625

- In every block of 20 samples extracted, there are 16 field samples, one blank, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate field sample.
- Five surrogate compounds are added to each sample in the block of 20.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- The GC/MS is checked and retuned, if necessary, every eight hours to ensure its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- GC performance criteria as specified in Method 625 are met before analysis starts.
- A calibration curve for quantitation is prepared using a minimum of 3 concentrations of a standard mixture of the priority pollutants of interest and 2,2'-difluorobiphenyl as internal standard.
- The calibration curve is verified with a standard priority pollutant mixture every eight hours.
- Results meet the acceptance criteria given in Method 625.

METHODOLOGY

The methods employed in the analysis of your sample are established EPA methods for priority pollutants. Combined gas chromatography and mass spectrometry (GC/MS) was used in the analysis of the organic compounds and atomic absorption spectrophotometry (AA) in the analysis of the metals.

For the analysis of the volatile organic compounds, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5-ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back flushed with helium to desorb the purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a mass spectrometer.

For the analysis of the Acid, Base/Neutral and Pesticide priority pollutants, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1-liter, was serially extracted with methylene chloride at a pH greater than 11 and again at pH less than 2 using a separatory funnel or a continuous extractor. The two methylene chloride extracts were individually dried and concentrated to a volume of 1 ml. The concentrates were injected into GC/MS systems set specifically for the separation and measurement of the priority pollutants.

Qualitative identification of the priority pollutants was performed initially using the relative retention times, the relative abundance of three characteristic ions and their ratios. The entire mass spectrum was reviewed before an identification was recorded. Quantitative analysis was performed using an internal standard with a single characteristic ion.

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Base/Neutrals Analysis (QR23)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7628

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	60
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	48
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	6
275	10-30% of mass 198	22
365	Greater than 1% of mass 198	2
441	Less than mass 443	14
442	Greater than 40% of mass 198	95
443	17-23% of mass 442	19

Date: 082183
Run No: 25754
Spectrum No: 112
Analyst: K. Weiner

August 26, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Decafluorotriphenylphospine (DFTPP) for Acids Analysis (QR22)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7628

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
51	30-60% of mass 198	31
68	Less than 2% of mass 69	<2
70	Less than 2% of mass 69	<2
127	40-60% of mass 198	51
197	Less than 1% of mass 198	<1
198	Base peak, 100% relative abundance	100
199	5-9% of mass 198	5
275	10-30% of mass 198	20
365	Greater than 1% of mass 198	2
441	Less than mass 443	7
442	Greater than 40% of mass 198	51
443	17-23% of mass 442	9

Date: 082183
Run No: 21591
Spectrum No: 243
Analyst: K. R. Weiner

August 30, 1983

TABLE 2: METHOD PERFORMANCE DATA

GC/MS Tuning Data – Bromofluorobenzene (BFB) for Volatiles Analysis (QR21)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7628

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours

m/z	Ion Abundance Criteria	Abundance (% Base Peak)
50	15-40% of the base peak	29
75	30-60% of the base peak	54
95	Base Peak, 100% relative abundance	100
96	5-9% of the base peak	7
173	Less than 1% of the base peak	<1
174	Greater than 50% of the base peak	65
175	5-9% of mass 174	5
176	Greater than 50% of the base peak	63
177	5-9% of mass 176	5

Date: 082283
Run No: 7384
Spectrum No: 27
Analyst: P. Krajczar

September 3, 1983

TABLE 2: METHOD PERFORMANCE DATA

Surrogate Recovery - GC/MS Data (QR20)

Chain of Custody Data Required for ETC Data Management Summary Reports

C7628

ETC Sample No. | Company | Facility | Sample Point | Date | Time | Elapsed Hours

Compound	Amount Added ug	% Recovery	Control Limits * Lower	Control Limits * Upper
VOLATILE FRACTION				
Bromochloromethane	.200	94	79	127
Benzene, d_6	.150	110	63	122
Fluorobenzene	.150	116	74	122
1,4-Dichlorobutane	.200	95	75	117
Pentafluorobenzene	.150	133**	58	124
Ethylbenzene, d_{10}	.150	116**	78	114
ACID FRACTION				
2-Fluorophenol	80	52	20	86
Pentafluorophenol	80	57	37	127
BASE/NEUTRAL FRACTION				
2-Fluorobiphenyl	80	94	62	122
1-Fluoronaphthalene	80	81	64	104
Nitrobenzene, d_5	80	89	58	105

* Three Standard Deviations About the Mean.

** Recovery affected by sample matrix interference.

August 30, 1983

TABLE 1: QUANTITATIVE RESULTS

Metals, Cyanide and Phenols – Analysis Data (QR05)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7628	J. SERRINE COMPANY	SINGLENLF	WW-2	830808	1210	

ES ber	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l
1	Antimony	ND	200
1	Arsenic	ND	200
1	Beryllium	ND	6
1	Cadmium	ND	20
1	Chromium	40	30
1	Copper	BMDL	10
1	Lead	ND	100
1	Mercury	BMDL	0.3
1	Nickel	ND	20
1	Selenium	ND	200
1	Silver	ND	20
1	Thallium	-	-
1	Zinc	140	9
1	Cyanide, Total	-	-
1	Phenolics, Total	-	-
	Aluminum	BMDL	100
	Boron	BMDL	40
	Barium	50	6
	Calcium	19000	1000
	Cobalt	ND	60
	Iron	ND	200
	Magnesium	6000	1000
	Manganese	120	7
	Molybdenum	BMDL	40
	Sodium	16000	1000
	Tin	ND	200
	Titanium	ND	7
	Vanadium	ND	9

ETC ENVIRONMENTAL TESTING and CERTIFICATION

September 3, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Base/Neutral Compounds - GC/MS Analysis Data (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7628	J. SERRINE COMPANY	SINGLENLF	MW-2	830808	1210	

DES Number	Compound	Results: Sample Concen ug/l	Results: * MDL ug/l	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Amount Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Extract ug/l	QC Matrix Spike: Amount Added ug/l	QC Matrix Spike: % Recov
2B	Fluorene	ND	10	ND	ND	ND	100	108	ND	102	92
3B	Hexachlorobenzene	ND	10	ND	ND	ND	100	92	ND	102	82
4B	Hexachlorobutadiene	ND	10	ND	ND	ND	100	3	ND	102	65
5B	Hexachlorocyclopentadiene	ND	10	ND	ND	ND	0	-	ND	0	-
6B	Hexachloroethane	ND	10	ND	ND	ND	100	0	ND	102	50
7B	Indeno(1,2,3-c,d)pyrene	ND	10	ND	ND	ND	0	-	ND	0	-
8B	Isophorone	ND	10	ND	ND	ND	100	69	ND	102	71
9B	Naphthalene	ND	10	ND	ND	ND	100	23	ND	102	71
0B	Nitrobenzene	ND	10	ND	ND	ND	100	75	ND	102	87
1B	N-Nitrosodimethylamine	ND	10	ND	ND	ND	0	-	ND	0	-
2B	N-Nitrosodi-n-propylamine	ND	10	ND	ND	ND	100	65	ND	102	65
3B	N-Nitrosodiphenylamine	ND	10	ND	ND	ND	100	98	ND	102	84
4B	Phenanthrene	ND	10	ND	ND	ND	100	138	ND	102	112
5B	Pyrene	ND	10	ND	ND	ND	100	85	ND	102	74
6B	1,2,4-Trichlorobenzene	ND	10	ND	3	ND	100	63	ND	102	66
	2,3,7,8-TCDD	ND	10	ND	ND	ND	0	-	ND	0	-

EPA Published Method Detection Limit.

ETC ENVIRONMENTAL TESTING and CERTIFICATION

September 3, 1953

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Base/Neutral Compounds – GC/MS Analysis Data (QR03)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7628	J. SERRINE COMPANY	SINGLENLF	WW-2	830808	1210	

ES ber	Compound	Results: Sample Concen. ug/l	Results: * MDL ug/l	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Amount Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Extract ug/l	QC Matrix Spike: Amount Added ug/l	QC Matrix Spike: % Recov
	Acenaphthene	ND	10	ND	ND	ND	100	96	ND	102	91
	Acenaphthylene	ND	10	ND	ND	ND	100	89	ND	102	87
	Anthracene	ND	10	ND	ND	ND	100	87	ND	102	90
	Benzidine	ND	10	ND	ND	ND	100	20**	ND	102	21**
	Benzo(a)anthracene	ND	10	ND	ND	ND	100	84	ND	102	61
	Benzo(a)pyrene	ND	10	ND	ND	ND	100	44**	ND	102	37**
3	Benzo(b)fluoranthene	ND	10	ND	ND	ND	100	36	ND	102	27
3	Benzo(ghi)perylene	ND	10	ND	ND	ND	0	-	ND	0	-
3	Benzo(k)fluoranthene	ND	10	ND	ND	ND	100	43	ND	102	36
3	bis(2-Chloroethoxy)methane	ND	10	ND	ND	ND	100	103	ND	102	105
3	bis(2-Chloroethyl) ether	ND	10	ND	ND	ND	100	96	ND	102	99
3	bis(2-Chloroisopropyl)ether	ND	10	ND	ND	ND	100	61	ND	102	108
3	bis(2-Ethylhexyl)phthalate	BMDL	10	17	60	ND	100	80	ND	102	58
3	4-Bromophenyl phenyl ether	ND	10	ND	ND	ND	100	105	ND	102	93
3	Butyl benzyl phthalate	ND	10	ND	ND	ND	100	91	ND	102	97
3	2-Chloronaphthalene	ND	10	ND	ND	ND	100	75	ND	102	84
3	4-Chlorophenyl phenyl ether	ND	10	ND	ND	ND	100	143	ND	102	122
3	Chrysene	ND	10	ND	ND	ND	100	94	ND	102	74
3	Dibenzo(a,h)anthracene	ND	10	ND	ND	ND	0	-	ND	0	-
3	1,2-Dichlorobenzene	BMDL	10	ND	6	ND	100	7**	ND	102	75
3	1,3-Dichlorobenzene	BMDL	10	ND	6	ND	100	5**	ND	102	72
3	1,4-Dichlorobenzene	ND	10	ND	ND	ND	100	4**	ND	102	52
3	3,3'-Dichlorobenzidine	ND	10	ND	ND	ND	100	36**	ND	102	27**
3	Diethyl phthalate	ND	10	ND	ND	ND	100	50	ND	102	56
3	Dimethyl phthalate	ND	10	ND	ND	ND	100	3**	ND	102	6**
3	Di-n-butyl phthalate	ND	10	ND	ND	ND	100	124**	ND	102	112**
7	2,4-Dinitrotoluene	ND	10	ND	ND	ND	100	99	ND	102	84
8	2,6-Dinitrotoluene	ND	10	ND	ND	ND	100	102	ND	102	89
9	Di-n-octyl phthalate	ND	10	ND	ND	ND	100	92	ND	102	71
0	1,2-Diphenylhydrazine	ND	10	ND	ND	ND	100	113	ND	102	96
1	Fluoranthene	ND	10	ND	ND	ND	100	100	ND	102	79

EPA Published Method Detection Limit.

* Recoveries norms [illegible] variable using EPA Protocol Method 625.

August 26, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Acid Compounds – GC/MS Analysis Data (QR02)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7628	J. SERRINE COMPANY	SINGLENLF	WW-2	830808	1210	

NPDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL* ug/l	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Amount Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Extract ug/l	QC Matrix Spike: Amount Added ug/l	QC Matrix Spike: % Recov
1A	2-Chlorophenol	ND	25	ND	ND	ND	150	91	ND	153	66
2A	2,4-Dichlorophenol	ND	25	ND	ND	ND	150	93	ND	153	78
3A	2,4-Dimethylphenol	ND	25	ND	ND	ND	150	60	ND	153	41
4A	4,6-Dinitro-o-cresol	ND	250	ND	ND	ND	250	79	ND	255	80
5A	2,4-Dinitrophenol	ND	250	ND	ND	ND	250	64	ND	255	79
6A	2-Nitrophenol	ND	25	ND	ND	ND	150	91	ND	153	78
7A	4-Nitrophenol	ND	25	ND	ND	ND	150	59	ND	153	46
8A	p-Chloro-m-cresol	ND	25	ND	ND	ND	150	85	ND	153	68
9A	Pentachlorophenol	ND	25	ND	ND	ND	150	98	ND	153	79
10A	Phenol	ND	25	ND	ND	ND	150	38	ND	153	28
11A	2,4,6-Trichlorophenol	ND	25	ND	ND	ND	150	100	ND	153	80

* EPA published Method Detection Limit.

August 30, 1983

TABLE 1: QUANTITATIVE RESULTS and QUALITY ASSURANCE DATA

Volatile Compounds – GC/MS Analysis Data (QR01)

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7628	J. SERRINE COMPANY	SINGLENLF	WW-2	830808	1210	

NPDES Number	Compound	Results: Sample Concen. ug/l	Results: MDL ug/l*	QC Replicate: First ug/l	QC Replicate: Second ug/l	QC Blank and Spiked Blank: Blank Data ug/l	QC Blank and Spiked Blank: Concen. Added ug/l	QC Blank and Spiked Blank: % Recov	QC Matrix Spike: Unspiked Sample ug/l	QC Matrix Spike: Concen. Added ug/l	QC Matrix Spike: % Recov
1V	Acrolein	ND	100	ND	ND	ND	1600	85	ND	1600	74
2V	Acrylonitrile	ND	100	ND	ND	ND	160	84	ND	160	88
3V	Benzene	ND	10	ND	3	ND	36	89	ND	36	90
4V	bis(Chloromethyl)ether	ND	10	ND	ND	ND	0	-	ND	0	-
5V	Bromoform	ND	10	ND	ND	ND	36	100	ND	36	94
6V	Carbon tetrachloride	ND	10	ND	ND	ND	36	97	ND	36	104
7V	Chlorobenzene	ND	10	ND	2	ND	36	94	ND	36	103
8V	Chlorodibromomethane	ND	10	ND	ND	ND	36	101	ND	36	99
9V	Chloroethane	ND	10	ND	ND	ND	36	102	ND	36	106
10V	2-Chloroethylvinyl ether	ND	10	ND	ND	ND	36	105	ND	36	97
11V	Chloroform	BMDL	10	ND	ND	ND	36	96	ND	36	96
12V	Dichlorobromomethane	ND	10	ND	ND	ND	36	101	ND	36	93
13V	Dichlorodifluoromethane	ND	10	ND	ND	ND	0	-	ND	0	-
14V	1,1-Dichloroethane	ND	10	ND	ND	ND	36	86	ND	36	87
15V	1,2-Dichloroethane	ND	10	ND	ND	ND	36	91	ND	36	88
16V	1,1-Dichloroethylene	ND	10	ND	ND	ND	36	86	ND	36	68
17V	1,2-Dichloropropane	ND	10	ND	ND	ND	36	79	ND	36	79
18V	1,3-Dichloropropylene	ND	10	ND	ND	ND	36	73	ND	36	81
19V	Ethylbenzene	ND	10	ND	ND	ND	36	96	ND	36	96
20V	Methyl bromide	ND	10	ND	ND	ND	36	102	ND	36	102
21V	Methyl chloride	ND	10	ND	ND	ND	36	90	ND	36	103
22V	Methylene chloride	BMDL	10	ND	ND	BMDL	36	78	9	36	42
23V	1,1,2,2-Tetrachloroethane	ND	10	ND	ND	ND	36	92	ND	36	86
24V	Tetrachloroethylene	ND	10	ND	ND	ND	36	99	ND	36	103
25V	Toluene	BMDL	10	ND	ND	ND	36	92	2	36	87
26V	1,2-Trans-dichloroethylene	ND	10	ND	ND	ND	36	88	ND	36	81
27V	1,1,1-Trichloroethane	ND	10	4	4	ND	36	97	ND	36	100
28V	1,1,2-Trichloroethane	ND	10	ND	ND	ND	36	98	ND	36	91
29V	Trichloroethylene	BMDL	10	ND	ND	ND	36	92	ND	36	94
30V	Trichlorofluoromethane	BMDL	10	ND	ND	ND	36	96	18	36	51
31V	Vinyl chloride	ND	10	ND	ND	ND	36	97	ND	36	103

* EPA published Method Detection Limit

INTRODUCTION

This report contains the analytical results on your water sample, WW2 830808 1210, submitted on August 10, 1983. It is designed to satisfy the needs of your people at various levels in your organization.

The results we obtained on your sample are presented in a tabular format immediately after this introduction. Included with the sample results, the quality assurance data on your specific sample are tabulated to verify the validity of the results obtained. The quality assurance data include those obtained on the surrogates, the blank, the spiked blank, the replicate and the spiked sample (commonly known as matrix spike). Also presented in the quality assurance data report is the verification of the proper functioning of the instruments used. The gas chromatograms and/or mass spectra generated in the analysis of your sample are included in the Appendix of the report. The chain of custody record for your sample is included at the end of this report.

The established methods we used in the analysis of your sample are described in the Methodology section after the Results. In the analysis we followed a rigidly controlled Quality Assurance Protocol. This Protocol is described after the Methodology section.

We hope our report format is useful in assisting you to obtain pertinent information on your sample.

RESULTS

The results obtained on your sample and the accompanying quality assurance data are listed in Table 1. The compounds of interest are listed with their NPDES (National Pollution Discharge Elimination System) number, and Method Detection Limit (MDL) published in the Federal Register, December 3, 1979. When a compound is detected below its MDL it is reported in Table 1 as BMDL (Below Method Detection Limit). When a compound is searched for and cannot be found it is reported as ND (Not Detected). The quality assurance data include results obtained on the Method Blank, Spiked Blank, Replicate, and Matrix Spike analyses. However, since the Replicate and Matrix Spike analyses were performed on samples randomly chosen in a sample batch, your specific sample may not be the selected one.

The data on the recovery of the surrogates in your sample and the certification of the GC/MS systems used in the analysis of your sample are listed in Table 2.

The Chain-of-Custody Record on your sample is also included at the end of this Report.

REPORT APPENDICES

The following appendices provide the support analytical data associated with your sample analyses. They are arranged as follows:

Appendix A

1) Reconstructed total ion chromatogram of GC/MS analyses of your sample.

2) The individual mass spectra of all priority pollutant compounds which have been identified as being present in your sample.

3) The individual mass spectra of the corresponding compounds as obtained from the standards.

Appendix B

1) The mass spectra of the calibration compounds, 4-bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), as obtained on the date of sample analyses.

Appendix C [for plus 10 and 50% internal standard option]

1) Spectra of tentatively identified compounds, with their differences.

Appendix D

1) Subcontractor's report.

These data are provided to present a complete report on your sample and to provide the data on which analytical decisions have been based. We hope this will aid you in your own analysis of the data.

Quality Assurance/Quality Control Proceedures (QA/QC)

ETC bases its quality assurance protocols on the following government guidelines:

- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March 1979;
- National Enforcement Investigation Center Policies, and Procedures manual; EPA-330/9/79/001-R, October 1979;
- the recommended guidelines for EPA Methods 624 and 625. (Federal Register, December 3, 1979, pp. 69532-69559); and
- "Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples," EPA 600/8-80-038, June 1980.

However, we have modified our protocols to provide a higher level of QA/QC than the guidelines require. For example, we analyze a higher than required number of quality control samples and we pay especially careful attention to the certification of the "reference standard" compounds we use in analysis. Below are listed the key QA/QC elements for the methods we use to analyze priority pollutants.

Analysis of Volatile Organic Compounds (EPA Method 624)

- Each batch of 13 samples consists of 9 customer samples (at maximum), one blank sample, one spiked blank, one spiked sample and one replicate sample. This amounts to a 30% quality control factor.
- Three surrogate compounds are added to each sample in the batch of 13.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.
- Each GC/MS is checked and retuned, if necessary, every 8 hours to ensure that its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of Volatile Organic Priority Pollutant "standards" at a minimum of 3 different concentrations and using a mixture of 3 internal standards at a constant concentration.
- The calibration curve is verified with a mixture of priority pollutant standards every 8 hours.
- Results are compared to the acceptance criteria given in Method 624; any that do not meet the criteria are re-analyzed.

Analysis of Organic Compounds Extracted in Acid or Base/Neutral Solutions (EPA Method 625)

- Each batch of 20 samples consists of 16 customer samples (at maximum), one blank sample, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate customer sample. This amounts to a 20% quality control factor.
- Five surrogate compounds are added to each sample in the batch of 20.
- At least one blind quality control sample is introduced to the laboratory for analysis for each hundred samples analyzed.

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are heterogeneous, the QC program is a minimum of 65% and consists of analyzing:

- each of the 30 customer samples in duplicate;
- 4 Replicates;
- 4 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Analysis of Mercury

To analyze samples for mercury we group them by matrix in batches of 20 or less. Our QC program is a minimum of 66% and consists of analyzing:

- each of the 20 customer samples in duplicate;
- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 10 Calibration standards (processed using the sample preparation method); and
- 2 Blanks.

Analysis of Pesticides, Herbicides and PCB's (EPA Method 608)

Pesticide, herbicide and PCB samples are grouped in batches of 16 customer samples or less according to the type of analysis to be performed. The QC program for each of these three types of analyses is a minimum of 20% and consists of analyzing:

- 1 blank sample;
- 1 spiked blank sample;
- 1 replicate sample;
- 1 replicate spiked sample; and
- 1 blank QC sample for at least each 100 samples analyzed.

The GC instruments are tuned daily to meet performance criteria in Method 608. Because Method 608 lacks data acceptance criteria, ETC has developed its own upper and lower quality control limits. When a test result falls outside the control limits, the test is re-run.

Analysis of Cyanides and Phenols

Cyanides and phenols are analyzed using a Technicon AutoAnalyzer II GT.

- Each GC/MS is checked and retuned, if necessary, every eight hours to ensure that its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a mixture of standards composed of either the Organic Acid or Base/Neutral Extractable Compounds at a minimum of 3 concentrations and using 2,2'-difluorobiphenyl as an internal standard.
- The calibration curve is verified with a mixture of priority pollutant standards every eight hours.
- Results are compared to the acceptance criteria given in Method 625; any that do not meet the criteria are re-analyzed.

Analysis of Metals

All Samples

- New standards are prepared for each batch of samples.
- Normal calibration is performed using a blank sample and four standards that have been through the sample preparation procedure. A regression analysis is used to construct the calibration curve.
- For each sample analysis that requires the use of the "method of additions" technique, a three point calibration is performed using U.S. EPA "Methods for Chemical Analysis of Water and Wastes, 1979". Results are obtained using linear regression analysis. Any results with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.
- In constructing the normal calibration curves the lowest concentration levels we use are values greater than or equal to 5 times the Instrumental Detection Limit (IDL).
- All calibration standards are analyzed in duplicate, at a minimum.
- Independent reference standards are used to check the accuracy of calibration standards.
- A check standard is analyzed every ten samples to validate the normal calibration curve.

Homogeneous Samples (except for Mercury analysis)

Samples are analyzed in batches of 30 or less. For batches in which the sample matrices are homogeneous, the QC program is a minimum of 42% and consists of analyzing:

- 3 Replicates;
- 2 Replicate spikes;
- 2 Replicate independent reference standards;
- 8 Calibration standards (processed using the sample preparation method);
- 2 Blanks (processed using the sample preparation method);
- 4 Calibration standards (without sample preparation); and
- 1 Blank (without sample preparation).

Heterogeneous Samples (except for Mercury analysis)

- Absorbance of full scale standards must be within +/- 25% of nominal absorbance.
- Duplicate calibration standards at four different concentrations are run with each batch of customer samples.
- At least one intersample standard is run for each 20 customer samples.
- Gain and carryover standards are analyzed at the end of each run.

Analysis of 2,3,7,8-TCDD (Dioxin)

A routine GC/MS scan for 2,3,7,8-TCDD (Dioxin) using Method 625 has a detection limit of approximately 10 ppb in a water matrix and 330 ppb in other matrices. The highly toxic nature of this compound may require analysis to one part per billion or lower. To reach this level of detection requires added safety precautions for laboratory personnel, dedication of a laboratory to such analyses, and special QA/QC techniques.

ETC has installed a high hazard laboratory adjacent to its main building for analysis of dioxin and other high hazard materials. The extraction techniques are rigorous. Analyses are based on Selected Ion Monitoring (SIM) and show dioxin concentrations as low as 0.1 ppb in water and 1 ppb in soils or sediments. SIM is essential to accurate quantitation of 2,3,7,8-TCDD since there are 21 other isomers with the same mass.

The QA/QC program consists of analyzing:

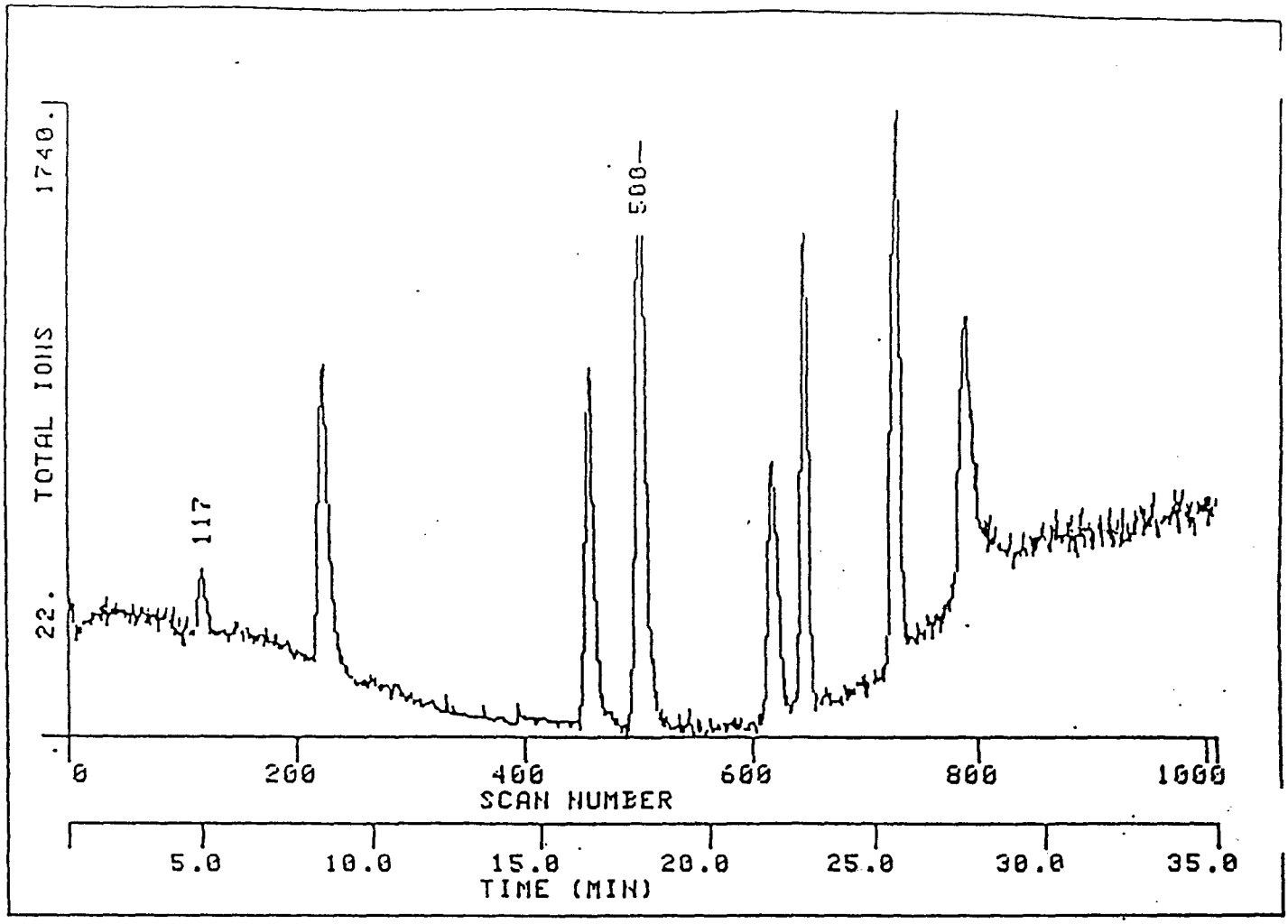
- each sample after spiking with a stable labeled radioactive (Carbon-13) analog of TCDD;
- a clean sample spiked with "native" TCDD supplied by the U.S. EPA Las Vegas laboratory;
- a replicate sample;
- a replicate sample that has been prepared using a Soxhlet extraction; and
- a method blank.

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person(s) breaking the Shuttle seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;
- disposition of each sample to an analyst or technician; and
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

TOTAL ION CHROMATOGRAM



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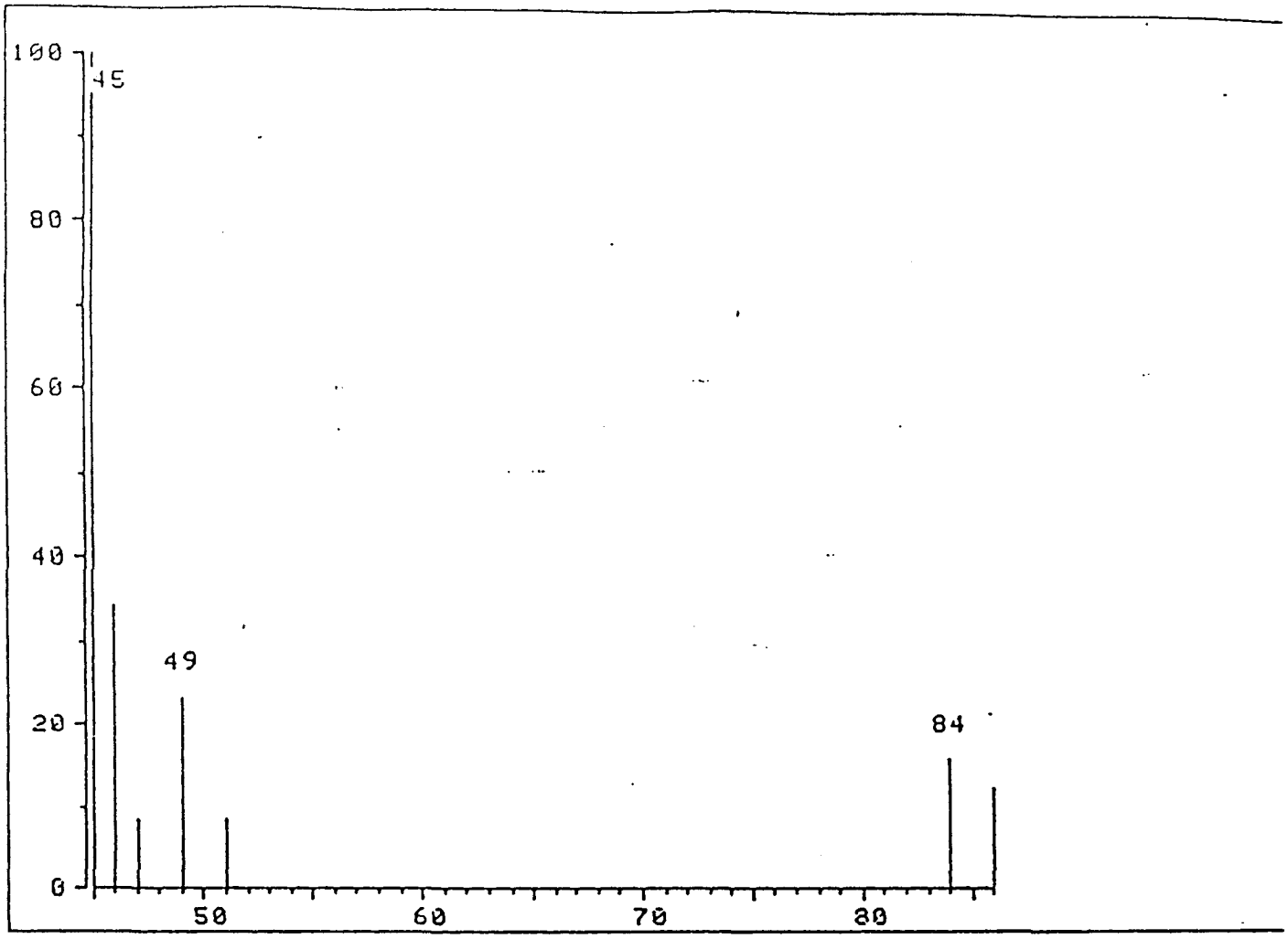

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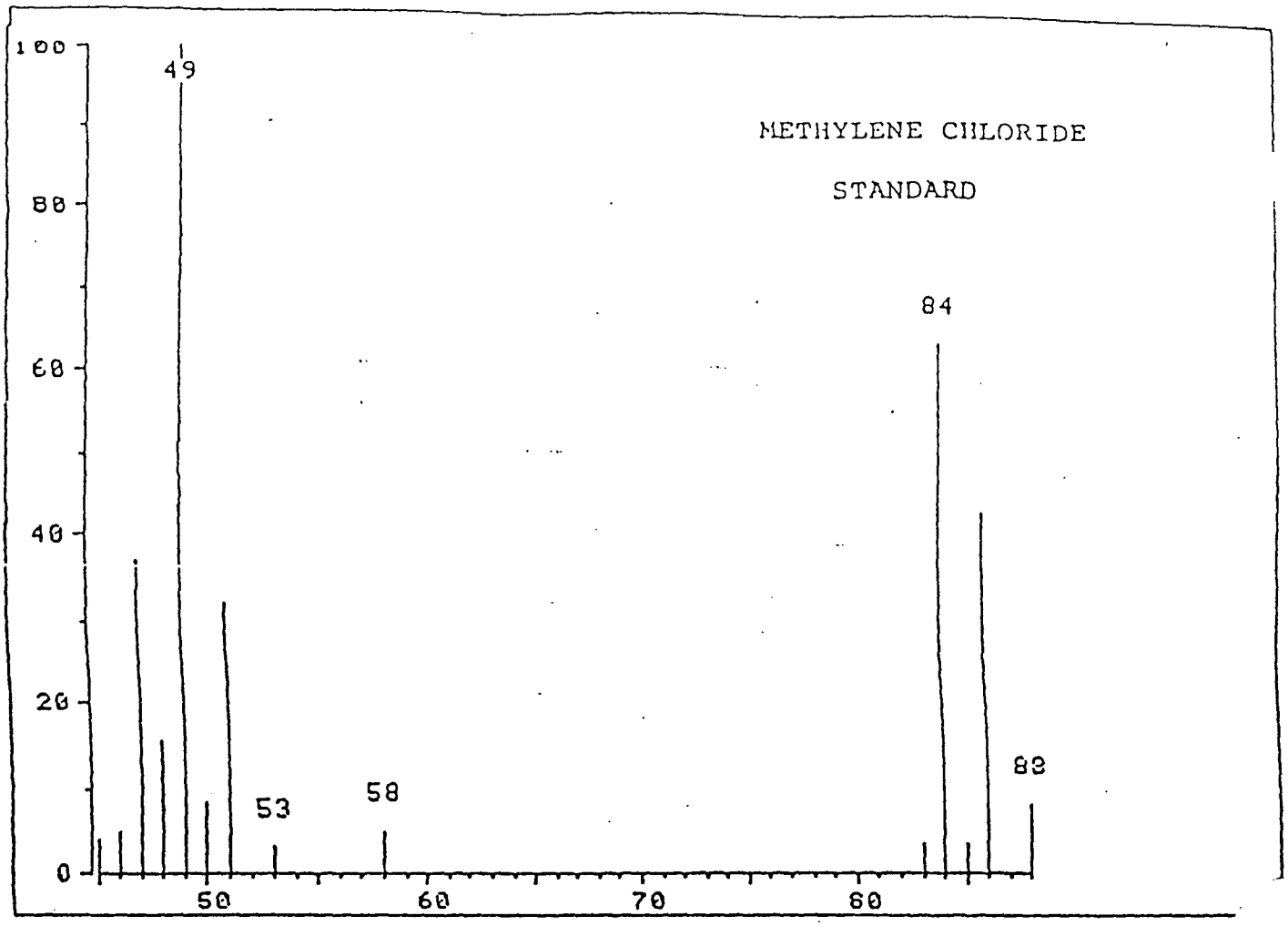
Compound Number: 21

Name: Methylene chloride
Scan Number: 117
Retention Time: 4.97 minutes
Major Peak Area: 190.0
Concentration: 100.0 NG

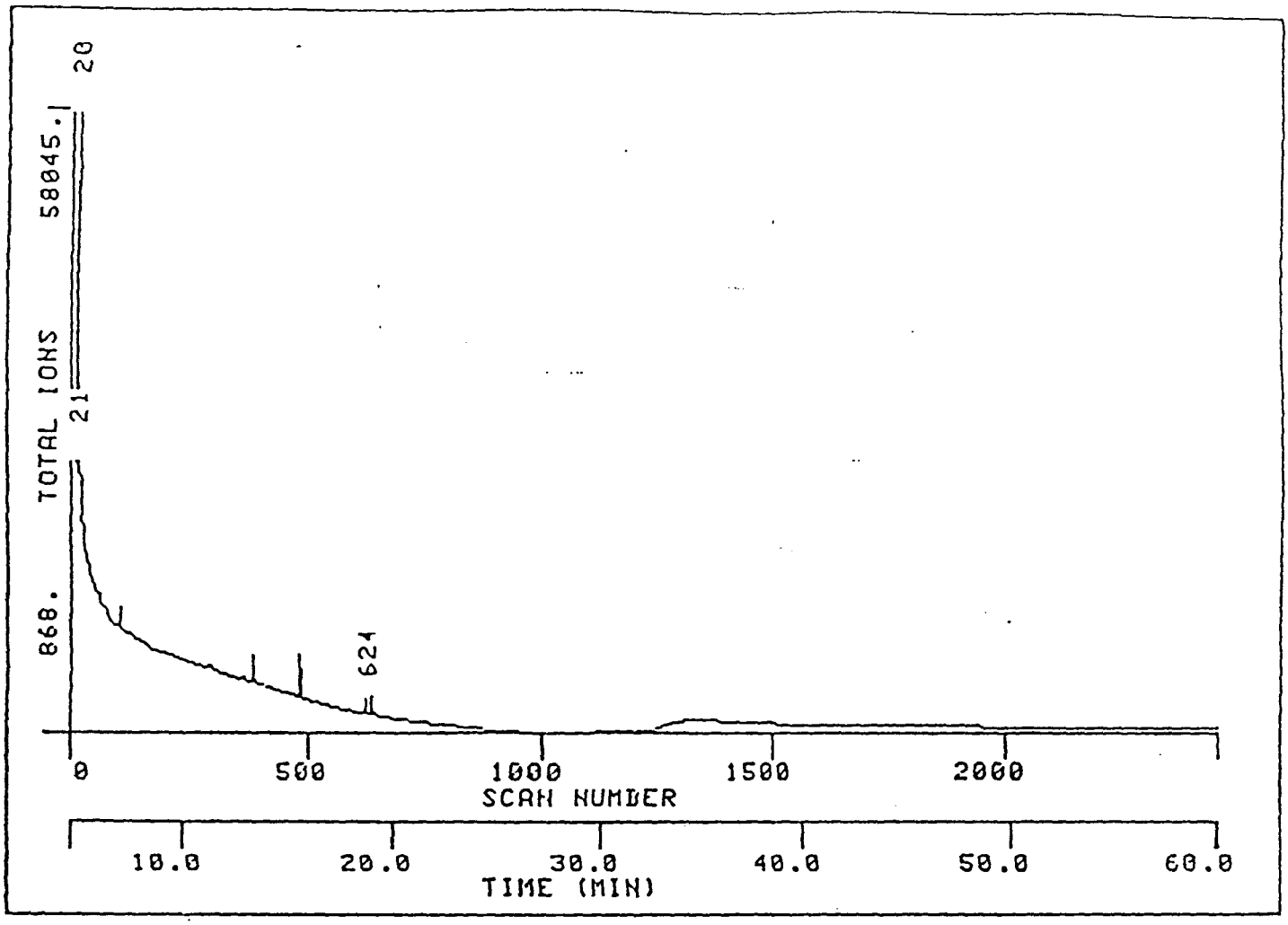


MS Data File FRN: 11327
Name: ETC SAMPLE QC STD (10UL 1167,10UL 1242,10UL 1294,6UL 1166,2U

Compound Number: 21

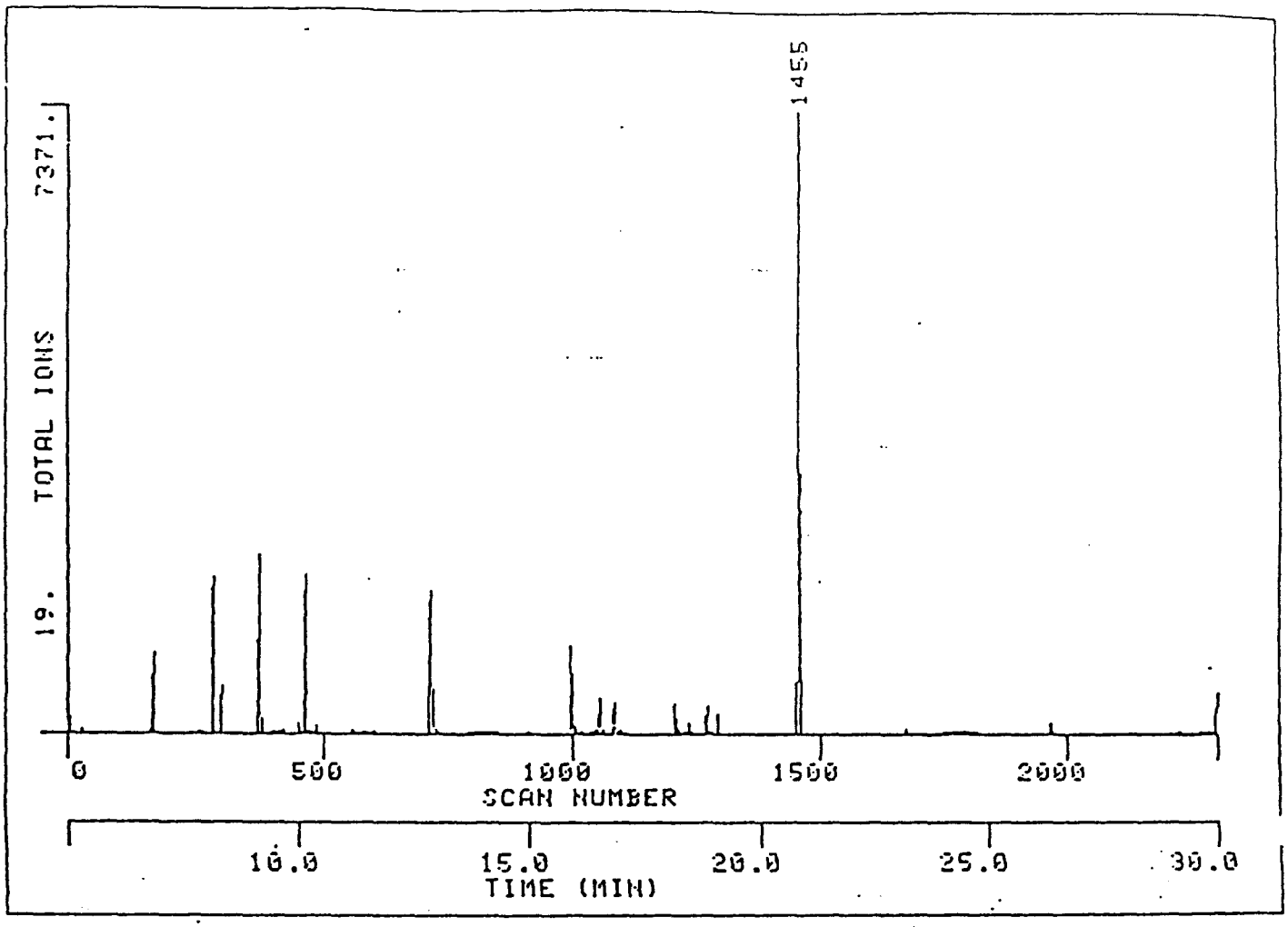
Name: METHYLENE CHLORIDE
Scan Number: 153
Retention Time: 6.42 minutes
Major Peak Area: 2210.0
Concentration: 40.6 PPB

TOTAL ION CHROMATOGRAM



MS Data File FRN: 25771
Name: C7629 BASE/NEUTRAL FRACTION 830821, E
Misc Data: C7629B BTL#16 D25771
Last R.T.: 60.0 minutes

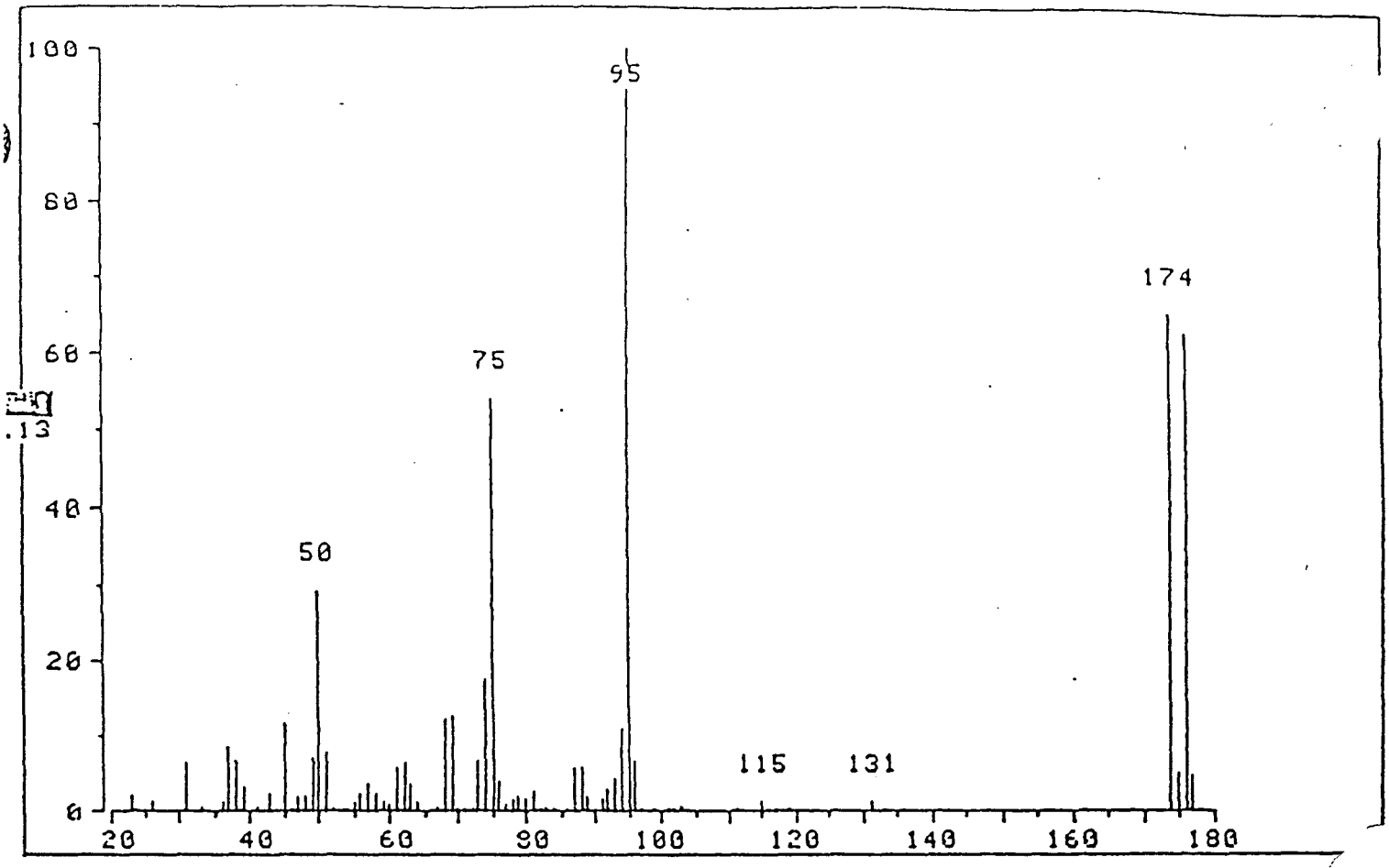
TOTAL ION CHROMATOGRAM



MS Data File FRN: 21611
Name: C7629 ACID FRACTION 830821, I
Misc Data: C7629A BTL#19 D21611
Last R.T.: 30.0 minutes

CALIBRATION COMPOUND
622 GC/MS A DKC SUD ×27

SCAN 7384



EPA CRITERION VERIFIER

7384
TRUM: 27

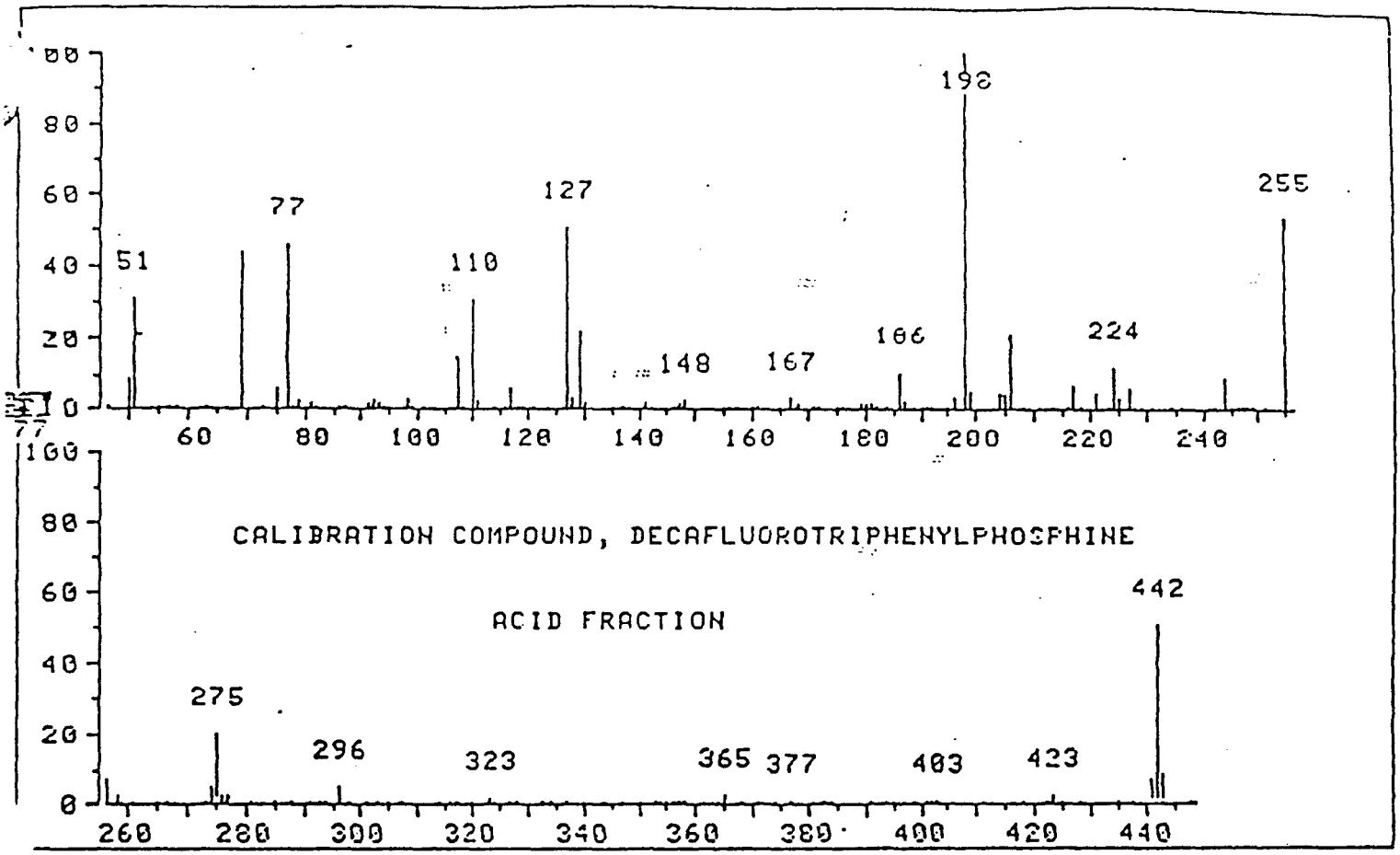
ass	Rel. Abund.	Criterion
0	29.0969	15-40% MASS 95
5	54.3313	30-60% MASS 95
5	100	BASE PEAK
5	6.875	5-9% MASS 95
73	0	<1% MASS 95
74	65.2531	>50% MASS 95
75	5.17813	5-9% MASS 174
76	62.8063	>50% MASS 95
77	4.80313	5-9% MASS 176

'**' indicates out of range!

<RETURN> TO RERUN...

; DFTPP BKSB *243 830821. I

21592

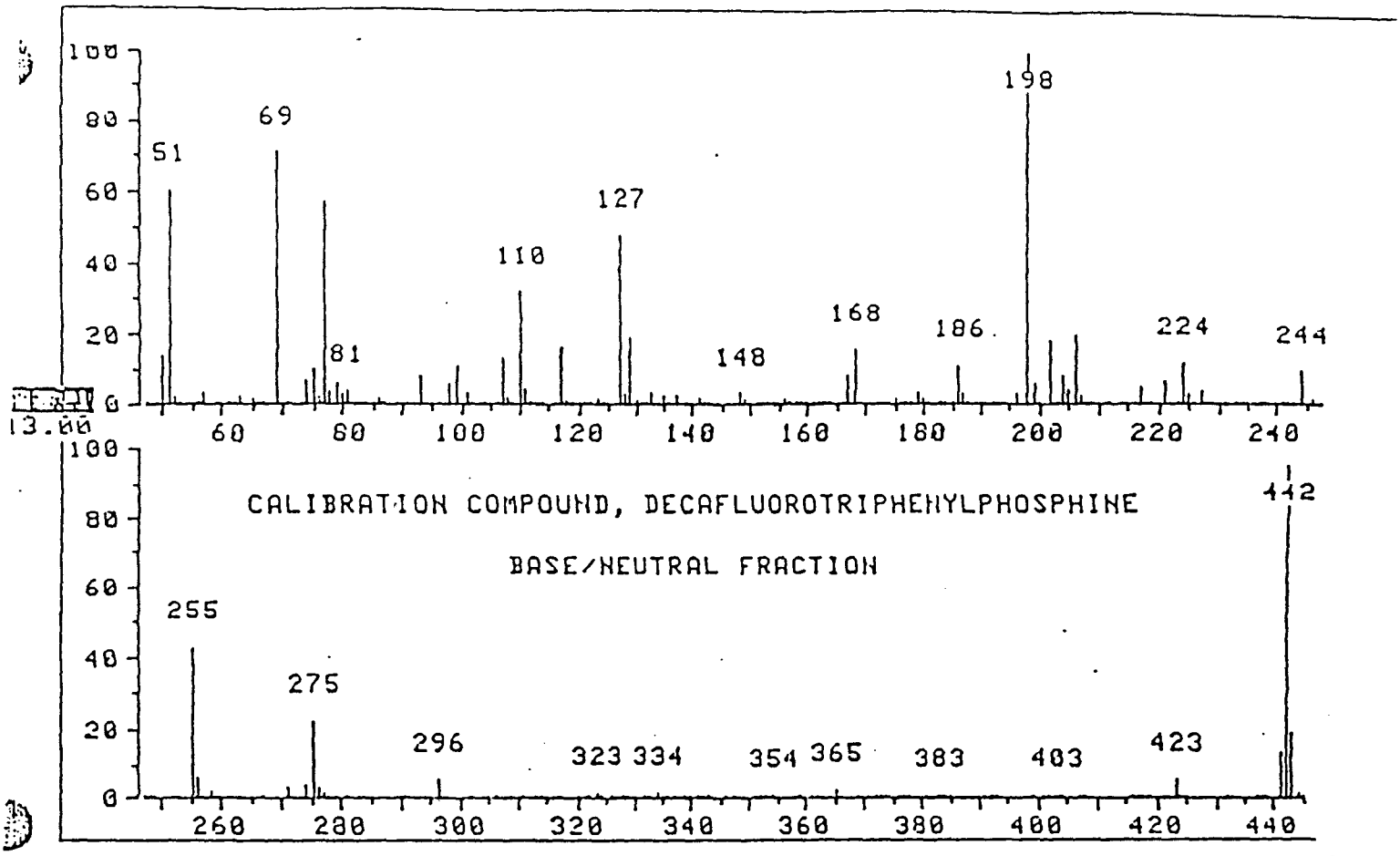


EPA CRITERION VERIFIER

21592
TRUM: 1

ass	Rel. Abund.	Criterion
1	30.8344	30-60% MASS 198
3	0	< 2% MASS 69
7	43.6594	
1	0	< 2% MASS 69
27	50.575	40-60% MASS 198
77	0	< 1% MASS 198
98	100	BASE PEAK
99	5.33125	5-9% MASS 198
75	19.7406	10-30% MASS 198
55	2.45	> 1% MASS 198
11	6.91562	< MASS 443
2	50.8656	> 40% MASS 198
3	8.93438	17-23% MASS 442

'**' indicates out of range!



TPP EPA CRITERION VERIFIER

N: 25755
ECTRUM: 1

Mass	Rel. Abund.	Criterion
51	59.9313	30-60% MASS 198
68	1.405	< 2% MASS 69
69	70.5094	
70	.203125	< 2% MASS 69
127	47.525	40-60% MASS 198
197	0	< 1% MASS 198
198	100	BASE PEAK
199	6.37187	5-9% MASS 198
275	22.1031	10-30% MASS 198
365	2.30625	> 1% MASS 198
441	13.6281	< MASS 443
442	95.2531	> 40% MASS 198
443	19.1875	17-23% MASS 442

OTE: '**' indicates out of range!

ETC TESTING AND CERTIFICATION

CHAIN OF CUSTODY FORM (CC1)

Seal Date: C 16629 7/20/83
Sealed By: D Farnell

SHIP TO:

Company: J SERVINE Co
Facility/Site: 216 S Pleasantburg Dr
Address: Greenville SC 29606
Attn: Bill Baskin
Phone: ( ) -

SAMPLE IDENTIFICATION

Facility/Site Code: E1-1101013 | | |

Grab

Source Codes:

Well — (W)	River/Stream — (R)	Surface Impoundment — (I)	Lake/Ocean — (L)
Soil — (S)	Bottom Sediment — (B)	Pretreatment Facility — (P)	Treatment Facility — (T)
Outfall — (O)	Generation Point — (G)	Leachate Collection Sys. — (C)	Other — (X)

Source Code (from above)	Your Sample Point ID (left justify)	Start Date (mo/day/yr)	Start Time (2400 hr. clock)	Elapsed Hours (composite)
W	WE1-1	018/018/813	1101/15	0 0
Sample: W	1101/U1216131P1	015/15/811	019130	1131

SHUTTLE CONTENTS

Sample Bottle	Condition	Sample Bottle	Condition
C7629 U1 to U2 ✓			
C7629 E1 to E2 ✓			
C7629 K1 ✓			
T7629 TB ✓			
C 7628 EXTBL	G1		

CHAIN OF CUSTODY CHRONICLE

Shuttle Opened By: (print) W.T. BASKIN Date: 8/1/83 Time: 9:30am
Signature: W J Baskin Seal #: 0022553 Intact: ✓

I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

I have received these materials in good condition from the above person.
Name: Signature:
Date: Time: Remarks:

Shuttle Sealed By: (print) W.T. BASKIN Date: 8/9/83 Time: 1345
Signature: W J Baskin Seal #: 0022554

ETC USE ONLY Opened By: D Farnell Date: 8/10/83 Time: 10:30a
Seal #: 22554 Condition: Seal intact

ETC ENVIRONMENTAL TESTING and CERTIFICATION

LABORATORY CHAIN-OF-CUSTODY

ETC Sample Number(s) C7627, C7628, C7629

Relinquished By D Farrell

Received By J. Bini Date 8/10/83 Time 7:00 p.m.

Relinquished By _____

Received By _____ Date _____ Time _____

Relinquished By _____

Received By _____ Date _____ Time _____

Relinquished By _____

Received By _____ Date _____ Time _____

Relinquished By _____

Received By _____ Date _____ Time _____

LABORATORY CHAIN-OF-CUSTODY CHRONICLE

ETC Sample Number(s) C7627, C7628, C7629

Sample Preparation For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Rick Powell	8/11/83
Acids	Rick Powell	8/11/83
Metals	J. Bini	8/11/83
Others BP/Org.	Rick Powell	8/11/83
Others		
Others		
Others		

Sample Analysis For:	Analyst	Date
Base/Neutral/PCB's & Pesticides	Kurt L. Fie	8/22/83
Acids	Kurt L. Fie	8/22/83
VOA/Purgeables	Carol Krajczy	8/22/83
Metals	J. Bini	8/15/83
Others		
Others		
Others		
Others		
Others		
Others		

Verified By [illegible]

September 1, 1983

TECHNICAL REPORT

for

J. Serrine Company
P.O. Box 5456
216 S. Pleasantburg Dr.
Greenville, SC 29606

Chain of Custody Data Required for ETC Data Management Summary Reports

ETC Sample No.	Company	Facility	Sample Point	Date	Time	Elapsed Hours
C7628	J. Serrine Company	SINGLENLF	WW-2	830808	1210	

ENVIRONMENTAL TESTING and CERTIFICATION CORPORATION

Denis C. K. Lin, Ph.D.
Vice President
Research and Operations

Chain-of-Custody

The chain-of-custody procedure is part of our quality assurance protocol. We believe our chain-of-custody record fully complies with the legal requirements of federal, state and local government agencies and of the courts of law. The record covers:

- labeling of sample bottles, packing the Sample Shuttle and transferring the Shuttle under seal to the custody of a shipper;
- outgoing shipping manifests;
- the chain-of-custody form completed by the person(s) breaking the seal, taking the sample, resealing the Shuttle and transferring custody to a shipper;
- incoming shipping manifests;
- breaking the Shuttle's reseal;
- storing each labeled sample bottle in a secured area;
- disposition of each sample to an analyst or technician and;
- the use of the sample in each bottle in a testing procedure appropriate to the intended purpose of the sample.

The record shows for each link in this process:

- the person with custody;
- the time and date each person accepted or relinquished custody.

Analysis of Metals (Sample, for all metals except Mercury)

For all homogeneous samples (minimum of 42% QC), each sample batch may include up to 30 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

For all heterogeneous samples (minimum of 65% QC), every field sample in a sample batch is run in duplicate. A sample batch may include up to 30 samples and the following fixed number of QC samples:

- 4 Replicates.
- 4 Replicate spikes.
- 2 Replicate independent reference standards.
- 8 Calibration standards (processed using the sample preparation method).
- 2 Blanks (using sample preparation method).
- 4 Calibration standards (without sample preparation).
- 1 Blank (without sample preparation).

Analysis of Metals (Sample, Mercury)

For every matrix (minimum of 66% QC), all the field samples in each sample batch are run in duplicate. A sample batch may include up to 20 samples and the following fixed number of QC samples:

- 3 Replicates.
- 2 Replicate spikes.
- 2 Replicate independent reference standards.
- 10 Calibration standards (processed using the sample preparation method).
- 2 Blanks.

Analysis of Metals (Standards)

- New working standards are prepared for each batch of samples.

- Normal calibration is performed using a blank and four standards that have been carried through the entire sample preparation procedure. A regression analysis is used to construct the calibration curve.

- For each sample analysis in the standard additions technique, a three point calibration is performed using U. S. EPA Methods for Chemical Analysis of Water and Wastes, 1979. Results are obtained using linear regression analysis. Any results obtained with a coefficient of correlation below 0.990 are considered erroneous, necessitating raw data editing or sample re-analysis.

- Normal calibration curves are constructed using greater than or equal to 5 times the Instrumental Detection Limit (IDL) as the lowest concentration level.

- All calibration standards are analyzed in duplicate, as a minimum.

- Independent reference standards are used to check the accuracy of calibration standards.

- A check standard is analyzed every ten samples to establish the validity of the normal calibration curve.

QUALITY ASSURANCE PROTOCOL

The quality assurance protocol followed in the analysis of your sample is based on the "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA-600/4-79-019, March, 1979; National Enforcement Investigation Center Policies and Procedures manual; EPA-330/9/79/001-R, October, 1979; and the recommended guidelines for EPA Method 624 and 625.

Our protocol calls for a higher percentage of quality assurance samples than the requirements of Method 624 and 625. The key QA elements for the analysis of priority pollutants are summarized as follows:

Method 624

- In every block of 10 samples, analysis of 7 field samples, one blank, one spiked sample and one replicate are performed. This amounts to a 30% quality control factor.
- A minimum of three surrogate compounds are added to each sample in the block of ten.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- The GC/MS is checked and retuned, if necessary, every eight hours to ensure its performance on bromofluorobenzene (BFB) meets the EPA criteria.
- A calibration curve for quantitation is prepared using a minimum of 3 concentrations of a standard mixture of the priority pollutants of interest and 3 internal standards (at a constant concentration).
- The calibration curve is verified with a standard priority pollutant mixture every eight hours.
- Results meet the acceptance criteria given in Method 624.

Method 625

- In every block of 20 samples extracted, there are 16 field samples, one blank, one spiked blank, one sample spiked with the priority pollutant standard mixture and a duplicate field sample.
- Five surrogate compounds are added to each sample in the block of 20.
- Blind quality control samples are included in field samples at a minimum of one every hundred samples.
- The GC/MS is checked and retuned, if necessary, every eight hours to ensure its performance on decafluorotriphenylphosphine (DFTPP) meets the EPA criteria.
- GC performance criteria as specified in Method 625 are met before analysis starts.
- A calibration curve for quantitation is prepared using a minimum of 3 concentrations of a standard mixture of the priority pollutants of interest and 2,2'-difluorobiphenyl as internal standard.
- The calibration curve is verified with a standard priority pollutant mixture every eight hours.
- Results meet the acceptance criteria given in Method 625.

ANALYSIS OF METALS

AQUEOUS

The determination of metals in aqueous samples was performed according to the methods published by EPA in "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March, 1979, and Appendix IV of the Federal Register, December 3, 1979. Arsenic, selenium and thallium were determined by furnace AA; silver, aluminum, barium, beryllium, boron, cadmium, calcium, chromium, copper, cobalt, iron, magnesium, manganese, molybdenum, nickel, lead, sodium, antimony, tin, titanium, vanadium, and zinc were determined by ICP emission spectrometry, except where lower levels of detection were required; in these cases (e.g. lead in groundwater monitoring samples) furnace AA was used. The determination of mercury was performed by cold vapor AA.

EP TOXICITY

The determination of metals in aqueous EP Toxicity leachates was performed according to the methods published by EPA in "Test Methods for Evaluating Solid Waste" EPA SW-846, July 1982, and Appendix IV of the Fed. Reg., Dec. 3, 1979. Silver, arsenic, barium, cadmium, chromium, lead and selenium were determined by ICP emission spectrometry. Mercury was determined using cold vapor AA. For leachates that are organic in nature, the analyses were performed according to the methods described under "OIL/SLUDGE," below.

SOIL/SEDIMENT

The determination of silver, beryllium, cadmium, chromium, copper, nickel, antimony, lead, and zinc in sediment samples was performed according to methods published by EPA in "Interim Methods for the Sampling and Analysis of Priority Pollutants in Sediments and Fish Tissue", EPA 600/4-81-055, October 1980. Mercury was determined according to the sediment method published by EPA in "Method for Chemical Analysis of Water and Wastes", EPA 600/4-79-020, March 1979. Arsenic, selenium and thallium were determined by furnace AA using nitric acid in a closed decomposition vessel for sample digestion.

OIL/SLUDGE

The determination of silver, aluminum, boron, barium, beryllium, calcium, cadmium, copper, chromium, cobalt, iron, magnesium, manganese, molybdenum, sodium, nickel, lead, antimony, tin, titanium, vanadium, and zinc in sludge/petroleum-based samples was performed by ICP emission spectrometry using a magnesium nitrate dry ashing digestion technique.

Arsenic, selenium and thallium were determined by furnace AA using nitric acid in a closed decomposition vessel for sample digestion. Mercury was determined by cold vapor AA using the same digestion technique.

METHODOLOGY

The methods employed in the analysis of your sample are established EPA methods for priority pollutants. Combined gas chromatography and mass spectrometry (GC/MS) was used in the analysis of the organic compounds and atomic absorption spectrophotometry (AA) in the analysis of the metals.

For the analysis of the volatile organic compounds, EPA Method 624 (Federal Register, December 3, 1979; page 69532) was used. The method can be summarized as follows: Helium is bubbled through a 5-ml water sample contained in a specially designed purging chamber at ambient temperature. The purgeable volatile organic compounds are efficiently transferred from the aqueous phase to the vapor phase. The vapor is swept through a sorbent column where the purgeables are trapped. After purging is completed, the sorbent column is heated and back flushed with helium to desorb the purgeables onto a gas chromatographic column. The gas chromatograph is temperature programmed to separate the purgeables which are then detected with a mass spectrometer.

For the analysis of the Acid, Base/Neutral and Pesticide priority pollutants, EPA Method 625 (Federal Register, December 3, 1979; page 69540) was used. The method can be summarized as follows: A measured volume of sample, approximately 1-liter, was serially extracted with methylene chloride at a pH greater than 11 and again at pH less than 2 using a separatory funnel or a continuous extractor. The two methylene chloride extracts were individually dried and concentrated to a volume of 1 ml. The concentrates were injected into GC/MS systems set specifically for the separation and measurement of the priority pollutants.

Qualitative identification of the priority pollutants was performed initially using the relative retention times, the relative abundance of three characteristic ions and their ratios. The entire mass spectrum was reviewed before an identification was recorded. Quantitative analysis was performed using an internal standard with a single characteristic ion.

LAW ENGINEERING TESTING COMPANY
Geotechnical and Materials Engineers
P.O. BOX 11297 · 501 MINUET LANE / CHARLOTTE, NORTH CAROLINA 28209 / (704) 523-2022

October 17, 1978

Singer Furniture Company
P. O. Box 1588
Lenoir, North Carolina 28645

Attention: Mr. Bill Cozart

Subject: Report of Preliminary Subsurface Investigation
Singer Furniture Plant Nos. 3 and 4 Additions
Miller Hill Road
Lenior, North Carolina
LETCo. Job No. CH 4155

Gentlemen:

As authorized by receipt of your Purchase Order No. 17105, Law Engineering Testing Company has completed a preliminary subsurface investigation at the subject site. This report describes the work performed and presents the results obtained, along with our preliminary evaluation and recommendations.

Generally, the investigation indicates that the areas located north of the existing metal warehouse and between plant No. 3 and the metal warehouse are questionable for development. Rather extensive undercutting of existing fill or the use of deep foundations would likely be required in these areas. The area south of Plant No. 3 appears to be the most suitable for development since shallow foundation support could be utilized in this area.

SITE AND PROJECT INFORMATION

The investigated areas are located adjacent to the Singer Furniture Plant Nos. 3 and 4, which are located on Miller Hill Road in Lenoir, North Carolina. We understand that expansion of these existing plants is currently proposed. Three areas are presently under consideration for expansion. One area is located north of an existing 100 by 160-ft, recently constructed, one-story metal warehouse building located on the north side of Plant No. 3. The ground surface in this area is generally level and covered with vegetation and debris. We understand that this area was used up until 1969 as a sanitary landfill for the City of Lenoir. The area extends northward a distance of approximately 300 ft beyond the existing metal building. A slope with a vertical height of 15 to 20 ft is located along the northern edge of this fill area. The ground surface below the bottom of the slope is wooded and appears to be part of the flood plain of a nearby creek.

The second area under consideration for plant expansion is located between Plant No. 3 and the previously described one-story metal building and measures approximately 140 by 500 feet. This area is level at about the same elevation as the previous area described above. A railroad spur line crosses this area and several storage tanks and other facilities and equipment are also located within this area.

The third area is located south of the warehouse and finishing room at the western end of Plant No. 3. Anticipated expansion is this area may

extend several hundred feet south of these existing structures. Presently, a loading and unloading area extends approximately 150 ft south of the existing building and is surrounded by a metal fence. A 25 to 35-ft high cut slope is located south of the metal fence. The top of this slope is relatively level and is wooded. No large rocks or boulders were observed in the face of this cut immediately south of the warehouse and finishing room area. However, intact rock with evidence of presplitting and blasting is exposed in the face of the cut slope located just east of the current proposed area of expansion.

We understand that plans for expansion are very preliminary at this time. No structural information is available. We assume that the proposed design grade for the new construction will be near the ground floor level of the existing plant.

FIELD INVESTIGATION

Soil Test Borings

Soil test borings were drilled in each of the three areas under consideration for plant expansion. Six shallow soil test borings and several additional offset borings were drilled in the most northern area. Three borings were drilled in the area adjacent to the north side of Plant No. 3 and two borings in the area south of plant No. 3. Approximate locations of the soil test borings are shown on the attached Boring Location Plan which we prepared from the furnished site plan entitled "The Singer Company, Plant Nos. 3 and 4,"

dated November 2, 1976. (Index No. 81766.72). We were not furnished any topographic information.

The borings were made by mechanical hollow stem augers. Soil sampling and penetration testing were performed in general accordance with ASTM Specification D-1586. At regular intervals, soil samples were obtained with a standard 1.4-inch I. D., 2-inch O. D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12 inches was recorded and is designated the "penetration resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength and ability to support foundations.

Representative portions of the soil samples thus obtained were placed in glass jars and transported to our laboratory. In the laboratory, the samples were examined by a soils engineer to verify the driller's field classifications. Test Boring Records are attached, graphically showing the soil descriptions and penetration resistances.

SUBSURFACE CONDITIONS

Lenoir is located in the Piedmont Physiographic Province of North Carolina, an area characterized by ancient igneous and metamorphic rocks. The virgin soils encountered in this area are the residual product of in-place chemical weathering

of the underlying parent bedrock. The typical residual soil profile generally consists of clayey soils near the surface where soil weathering is more advanced, underlain by sandy silts and silty sands that generally become harder with depth to the top of parent bedrock. The boundary between soil and rock is not clearly defined; therefore, the transitional zone termed "partially weathered rock" is defined, for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot. Weathering is facilitated by fractures, joints and the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and zones of partially weathered rock within the soil, well above the general bedrock level.

Quite often, the upper soils along drainage features and in flood plain areas are water-deposited (alluvial) materials that have been eroded and washed down from adjacent higher ground. These alluvial soils are usually soft and compressible, having never been consolidated by pressures in excess of their present overburden.

Area North of Metal Warehouse

All of the soil test borings and offset borings drilled within this area (borings B4 thru B9A) encountered man-made fill underlain by refusal material at a depth ranging from 2.5 to 6 ft below existing grade. The man-made fill

consists of sandy clayey silt and silty sand with numerous rock fragments. The standard penetration resistances recorded in such material are unreliable as to the true consistency due to probable amplification in the blow count caused by the split-spoon sampler striking the numerous hard fragments. Refusal to the soil drilling equipment may result from hard rock lenses, rubble, boulders or the upper surface of sound continuous rock. Diamond core drilling procedures would be required to penetrate and retrieve samples in order to determine the nature and continuity of the refusal material. Diamond core drilling was not performed in this area.

In all likelihood, the refusal material encountered by these borings consist of man-made rock fill, possibly from the excavation at the south end of Plant No. 3. We learned from plant personnel that rock ranging in size from cobbles to boulders was placed in this area over the underlying fill material.

Area Between Plant No. 3 and Metal Warehouse

Borings B-1, B-2, B-3 and B-3A were drilled in this area. An upper layer of man-made fill was encountered to a depth of 13 ft in B-1, 3 ft in B-2 and 8 ft in B-3. The fill consists of clayey sandy silt and silty sand and contains numerous rock fragments. The fill encountered in boring B-1 also contains fragments of wood and glass. The penetration resistances recorded in these fill materials are unreliable as to the true consistency due to the

numerous hard fragments present. Below this fill, material described as fill or possible alluvium was encountered from a depth of 13 to 20 ft in B-1 and 8 to 11 ft in B-3. This fill or possible alluvium consists of firm to stiff sandy clayey silt and sandy silty clay with rounded gravel.

Below the fill or possible alluvium, residual soils resulting from the in-place chemical weathering of parent rock were encountered at a depth of 20 ft in B-1 and 3 ft in B-2. These residual soils consist of firm to dense micaceous silty sand. Possible residual material was encountered from 11 ft to auger refusal at 13 ft in B-3. No sample was recovered of this latter material. Offset boring B-3A was drilled approximately 20 ft northeast of B-3 to help determine the lateral extent of the refusal material. Boring B-3A was augered to a depth of 8.5 ft without soil sampling. Below this depth, fill consisting of sandy clayey silt with rock fragments was encountered to a depth of 10 feet. Possible fill soils consisting of silty sand were encountered from 10 ft to auger refusal at 12 feet. Since diamond core drilling was not performed in borings B-3 or B-3A, it is not known whether the refusal material is boulder or rubble fill or the surface of intact rock.

Area South of Plant No. 3

Two soil test borings, B-10 and B-11, were drilled at the top of the cut slope in this area. Both borings encountered residual soils from the ground surface consisting of stiff micaceous sandy silt and firm to dense silty sand with weathered rock fragments. Partially weathered rock was encountered below the residual soil at a depth of 29 ft in B-10 and 20 ft in B-11. Boring B-11

was terminated in partially weathered rock at a depth of 29.5 feet. Below the continuous partially weathered rock, boring B-10 encountered refusal at a depth of 31 feet. No rock coring was performed in boring B-10 to determine the nature and continuity of the refusal material.

All of the borings, with the exception of B-1, were dry at the time of drilling. Groundwater was encountered at a depth of 19 ft in B-1 at the time of drilling. Groundwater levels may fluctuate several feet with seasonal rainfall variations and with changes in the water level in adjacent streams. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

Details of the subsurface conditions encountered in the borings are presented on the attached Test Boring Records.

PRELIMINARY EVALUATION AND RECOMMENDATIONS

Area North of Metal Warehouse

Due to the refusal material encountered at shallow depth in all borings drilled within this area, the nature of the deeper subsurface material is not known. However, based on knowledge gained from plant personnel familiar with this area, we anticipate that the deeper material consists of fill containing debris and other fragments. This material would not provide adequate foundation support for shallow foundations. If the debris fill does not extend to significant depth and competent soil exists below it, it would perhaps be possible to undercut this material and replace it with compacted structural fill.

If the fill extends to considerable depth, a feasible foundation alternative would be driven timber or steel H-piles deriving support primarily from end bearing. If significant amounts of rock and other large debris are present throughout the fill depths (as indicated by the borings), timber piles would probably not be feasible due to the likelihood of damage to the piles upon striking such material. Timber piles could be used, however, if holes could be predrilled by large caisson-type equipment or excavated with a backhoe through the fill prior to installation of piles. Heavy steel H-piles with built up end sections could possibly be driven through the debris fill without the necessity for predrilling. However, if large boulders or other large pieces of debris are present in the fill, even the heavy steel H-piles would likely not be able to penetrate these materials to reach competent bearing material and excavation through the rubble fill with a large backhoe would be required.

Additional subsurface information would be necessary to provide more specific recommendations for foundation design in this area. Test pits excavated by a backhoe would be required to determine the nature and vertical extent of the refusal material. If this refusal material consists of a layer of rock which can be penetrated by the backhoe, it may be possible to extend soil test borings down into the bottom of the pits in order to determine the nature of the deeper fill material and the depths of competent material for end-bearing piles. If test pits reveal that impenetrable large

rock and other large debris is present throughout the fill depths, it is our opinion that the area should not be further considered for development unless it is economically justifiable to remove all such material and replace it with approved structural fill.

Area Between Plant No. 3 and Metal Warehouse

Although fill was encountered by the three soil test borings drilled within this area, the fill does not appear to contain the type and extent of debris that is present within the former sanitary landfill in the area north of this one. However, the existing fill in this area is not considered suitable for support of shallow foundations. Extensive depths of fill were encountered in borings B-1 and B-3. Shallow foundations could likely be used in this area by undercutting the existing fill below the depth stressed by footings and replacing the undercut fill material with compacted structural fill. If the undercut material does not contain significant amounts of deleterious material such as large rock fragments and organic material, it could likely be re-used as structural fill. Boring B-2 encountered competent residual soil adequate for shallow foundation support below a few feet of fill.

Another foundation alternative which appears feasible in this area, based upon the preliminary subsurface information, is a system of driven timber or steel H-piles. The piles would derive support from a combination of side friction and end bearing. Additional soil test borings would be required to determine the minimum tip elevations and working loads for driven piles.

Area South of Plant No. 3

Residual material which could probably be removed by conventional earthmoving equipment was encountered to a depth of about 20 ft in boring B-10 and 29 ft in B-11. The partially weathered rock encountered below these depths would likely require heavy excavating equipment with ripping tools for efficient excavation. As previously stated, the refusal material encountered at a depth of 31 ft in B-10 may be a boulder, a lense of hard rock or may be the upper surface of sound continuous rock. The use of pneumatic hammers and blasting would likely be required for excavation of such material. Since the two borings are widely spaced, it is entirely possible that partially weathered rock or hard rock could be encountered at a higher elevation between the borings.

Based on the results of borings B-10 and B-11, we anticipate that bearing pressures for shallow foundations ranging from 5000 psf in residual soil up to 10,000 psf in partially weathered rock or hard rock would be available. In order to verify these bearing pressures, several additional shallow soil test borings should be drilled within the proposed building area.

QUALIFICATION OF REPORT

Our evaluation of foundation support conditions for this preliminary subsurface investigation has been based on our understanding of the project and site information and the data obtained in our investigation. The general

subsurface conditions utilized in our evaluation of foundations are based on interpolation of subsurface data between the widely spaced borings. In evaluating the boring data obtained in this preliminary subsurface investigation, we have examined previous correlations between penetration resistances and foundation bearing pressures observed in soil conditions similar to those at your site.

The foundation recommendations stated in this report are only preliminary in nature and not intended for use in final foundation design. When the project plans are finalized, we will be glad to work with you in establishing the final investigative program required to give detailed soil and rock-related recommendations for foundation design and site preparation.

Law Engineering Testing Company appreciates the opportunity to provide our geotechnical engineering services on this project. If you have any questions concerning this report or if we may be of further assistance to you during the final design and construction phases of this project, please contact us.

Very truly yours,

LAW ENGINEERING TESTING COMPANY

Mel Y. Browning

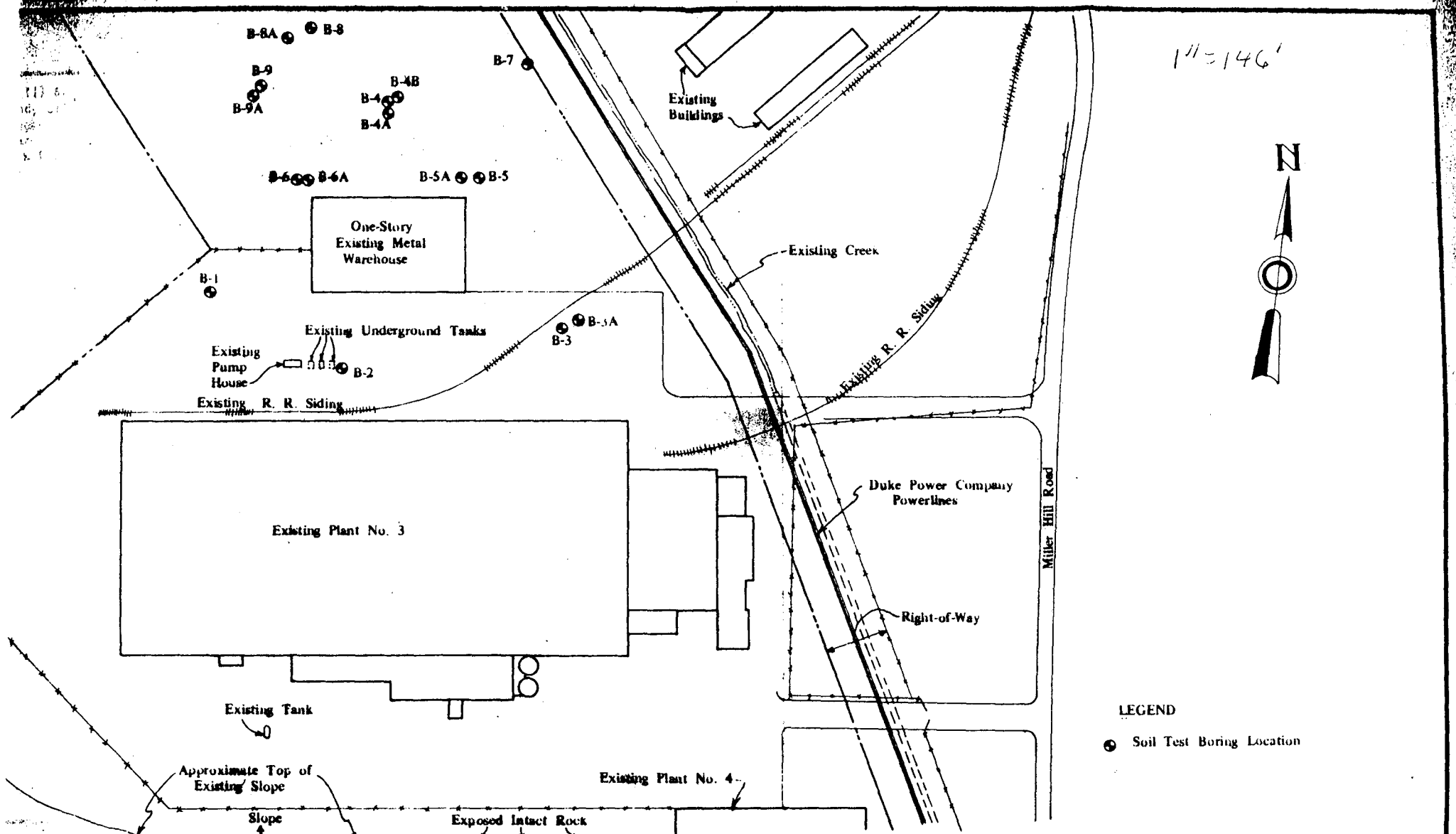
Mel Y. Browning, E. I. T.
Staff Soils Engineer

Jon H. Gould

Jon H. Gould, P. E.
Chief Engineer
Registered, N. C. 7582

MYB/JHG/cm

Attachments



LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

Singer Furniture Company
Lenoir, North Carolina

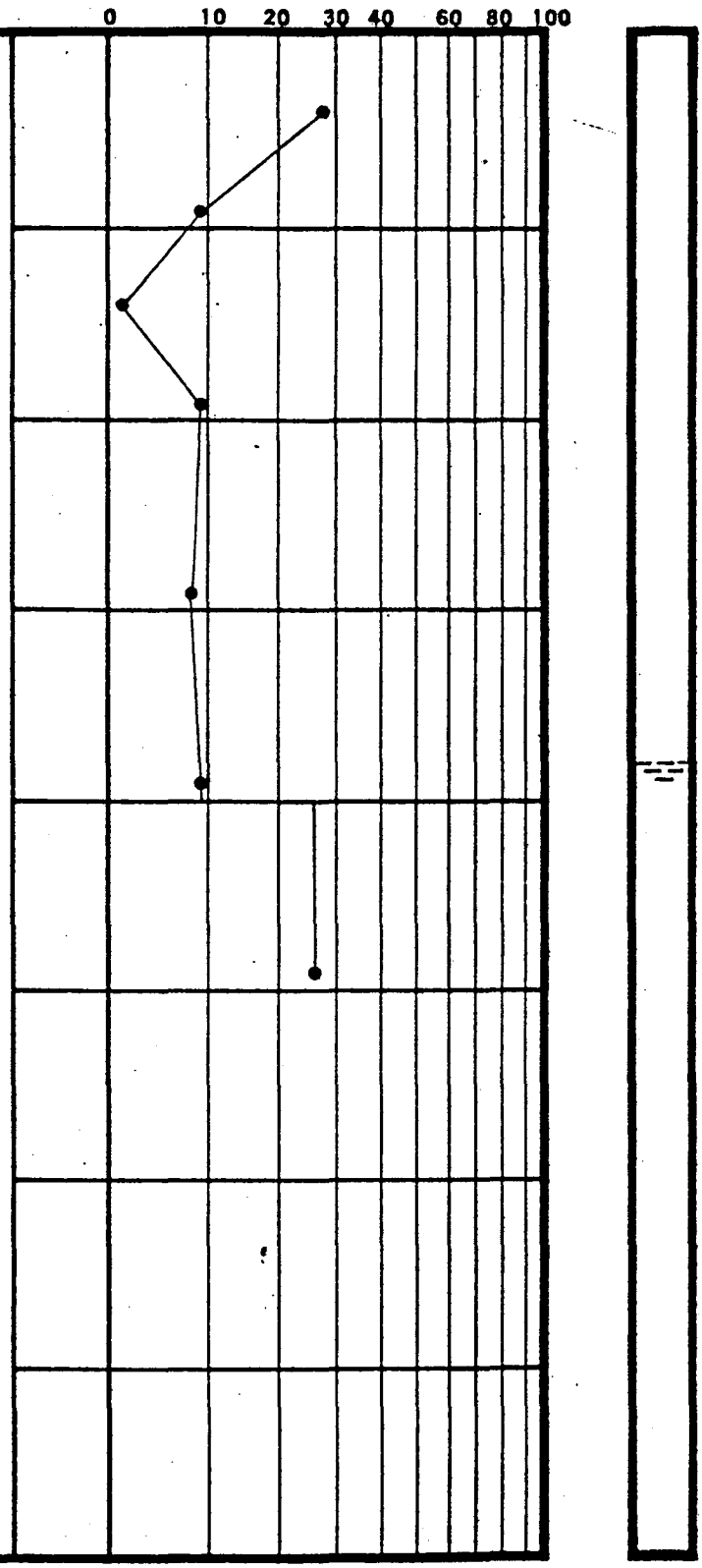
Boring Location Plan
Singer Furniture Plant Numbers 3 and 4
Miller Hill Road
Lenoir, North Carolina

DWN. BY	RST		SCALE: 1"=100'
CKD. BY	MYB		DRAWING NO. CH 4155
APPR'D.	JHG		

Ref: Drawing Entitled, "The Singer Company, Plant Nos. 3 and 4, Lenoir, North Carolina" dated November 2, 1976 (Index No. 81766.72)

DEPTH FT.	DESCRIPTION
	(Fill) Brown Clayey Fine to Coarse Sandy Silt With Rock And Wood Fragments to Black Silty Fine to Coarse Sand With Wood, Glass and Rock Fragments
6.0	(Fill or Possible Alluvium) Firm to Stiff Tan Brown to Blue Gray and Tan Micaceous Fine to Medium Sandy Clayey Silt
1.0	(Residual) Firm Gray Green Micaceous Silty Fine to Medium Sand
5.0	Boring Terminated At 25.0 Feet Groundwater Encountered At 19 Feet At Time of Boring

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-1

DATE DRILLED 8/31/78

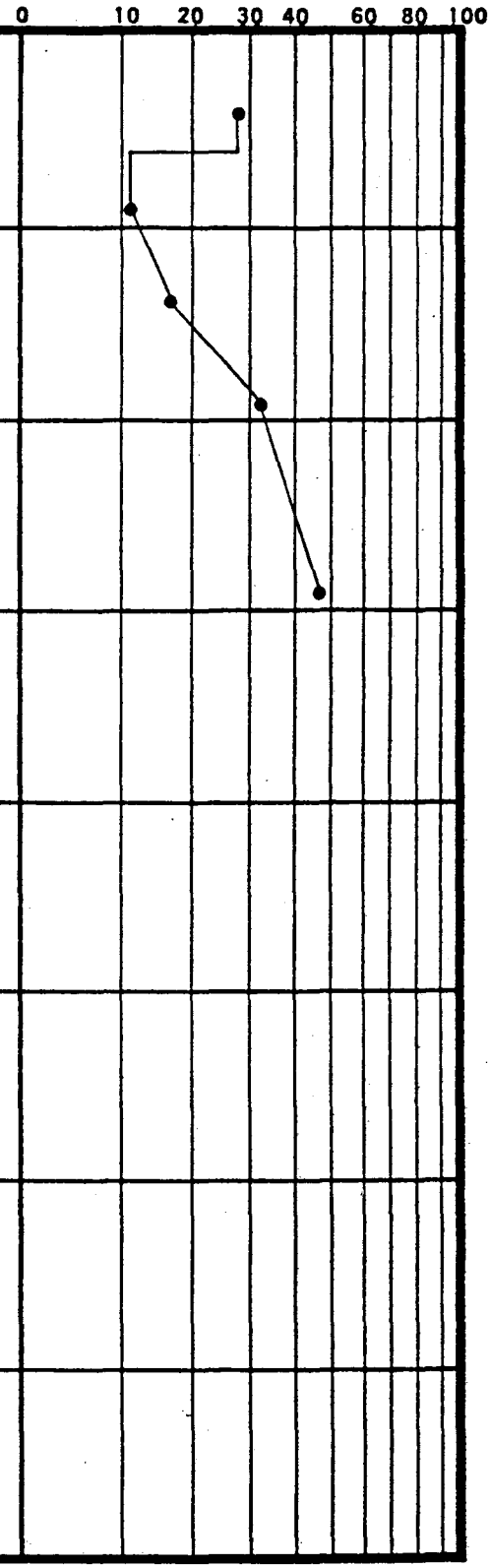
JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	(Fill) Green Gray Micaceous Silty Fine to Coarse Sand With Rock Fragments
6	(Residual) Firm Green Gray Very Micaceous Silty Fine Sand to Gray Brown and White Micaceous Silty Fine Sand
0	Dense Gray Brown to Green Gray Silty Fine to Coarse Sand
0	Boring Terminated At 15.0 Feet No Groundwater Encountered At Time of Boring

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
'RE DRILLING MEETS ASTM D-2113

.NETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-2

DATE DRILLED 8/31/78

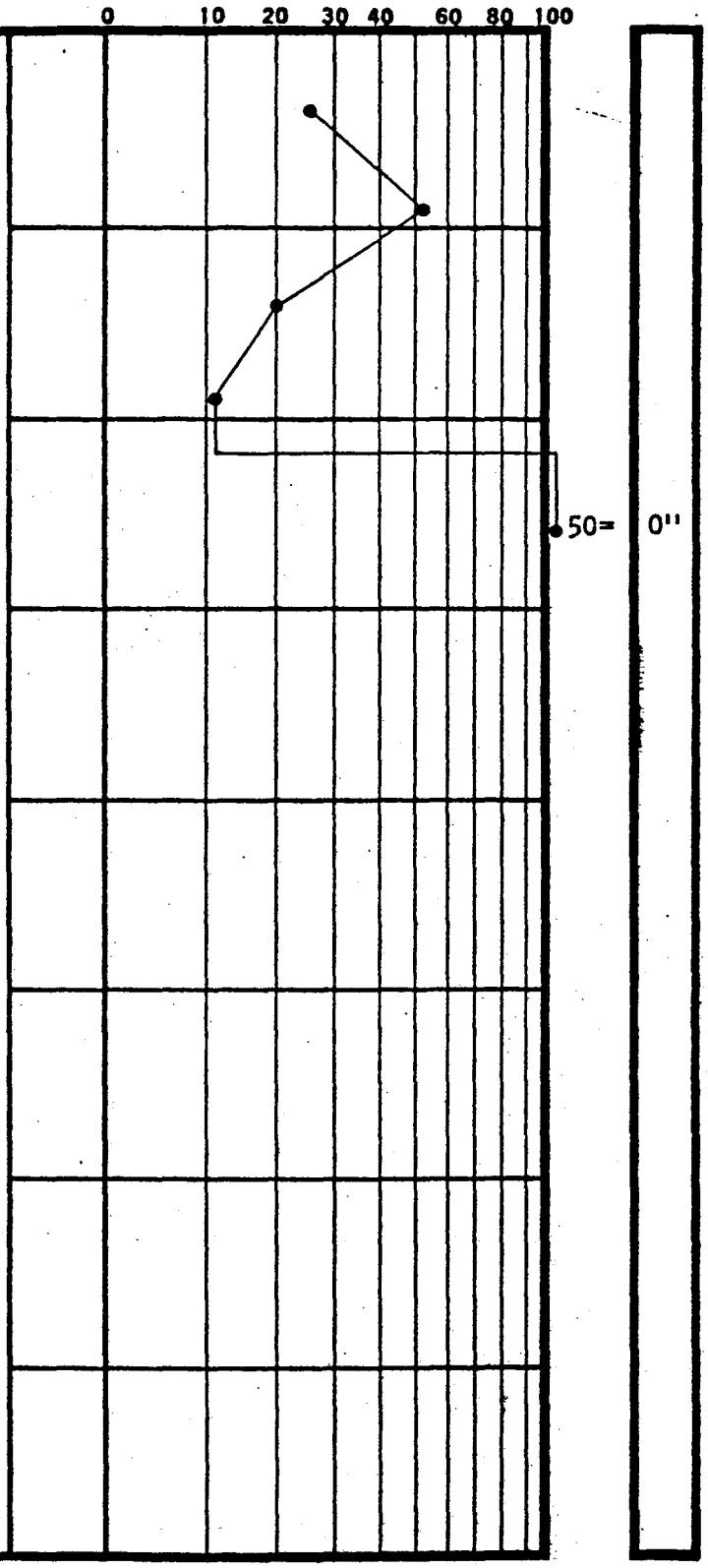
JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	Crushed Stone
.0	(Fill) Gray Green Micaceous Silty Fine to Coarse Sand With Rock Fragments
.0	(Fill or Possible Alluvium) Tan Brown Fine to Coarse Sandy Silty Clay With Rounded Gravel
.0	(Possible Residual - No Samples Obtained)
.0	Auger Refusal At 13.0 Feet Boring Terminated At 13.0 Feet No Groundwater Encountered At Time of Boring

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-3

DATE DRILLED 8/31/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
	Augered From 0 to 8.5 Feet Without Soil Sampling	
8.5	(Fill) Red Brown Fine to Coarse Sandy Clayey Silt With Rock Fragments	●
10.0	(Possible Fill) Tan Gray Silty Fine to Coarse Sand With Rock Fragments	
12.0	Auger Refusal At 12.0 Feet Boring Terminated At 12.0 Feet No Groundwater Encountered At Time of Boring	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-3A

DATE DRILLED 8/31/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100	
0	(Fill) Red Tan Micaceous Fine to Coarse Sandy Clayey Silt With Rock Fragments	50=	6"
	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-4

DATE DRILLED 9/1/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Red Tan Micaceous Fine to Coarse Sandy Clayey Silt With Rock Fragments	
3.5	Auger Refusal At 3.5 Feet Boring Terminated At 3.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

50 % ROCK CORE RECOVERY

TEST BORING RECORD

BORING NO. B-4A

DATE DRILLED 9/1/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Brown Fine to Coarse Sandy Clayey Silt With Rock Fragments	
.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

50 % ROCK CORE RECOVERY

TEST BORING RECORD

BORING NO. B-4B

DATE DRILLED 9/1/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
	(Fill) Green Gray Micaceous Silty Fine to Coarse Sand With Rock Fragments	
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-5

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Red Brown Micaceous Clayey Silty Fine to Coarse Sand With Rock Fragments	
5	Auger Refusal at 3.5 Feet Boring Terminated at 3.5 Feet No Groundwater Encountered at Time of Boring No Groundwater Encountered After 24 Hours	

ORING AND SAMPLING MEETS ASTM D-1586
ORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-5A

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH FT.	DESCRIPTION		● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100		
0	(Fill) Rock Fragments			50=	0"
3.5	Auger Refusal At 3.5 Feet Boring Terminated At 3.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours				

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-6

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
	(Fill) Green Brown Silty Fine to Coarse Sand With Rock Fragments	
6.0	Auger Refusal At 6.0 Feet Boring Terminated At 6.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-6A

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)	
	(Fill) Blue Gray Slightly Silty Fine to Coarse Sand With Rock Fragments	●50=	6"
5.5	Auger Refusal At 5.5 Feet Boring Terminated At 5.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-7

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Fill) Red Brown Silty Fine to Coarse Sand With Rock Fragments	
4.5	Auger Refusal At 4.5 Feet Boring Terminated At 4.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-7A

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100	
	(Fill) Red Brown Silty Fine to Coarse Sand With Rock Fragments	●50=	0"
2.5	Auger Refusal At 2.5 Feet Boring Terminated At 2.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-8

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
	(Fill) Red Brown Silty Fine to Coarse Sand With Rock Fragments	
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-8A

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100	
	(Fill) Brown Silty Fine to Coarse Sand With Rock Fragments	●50=	0"
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-9

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Brown Silty Fine to Coarse Sand With Rock Fragments	
	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-9A

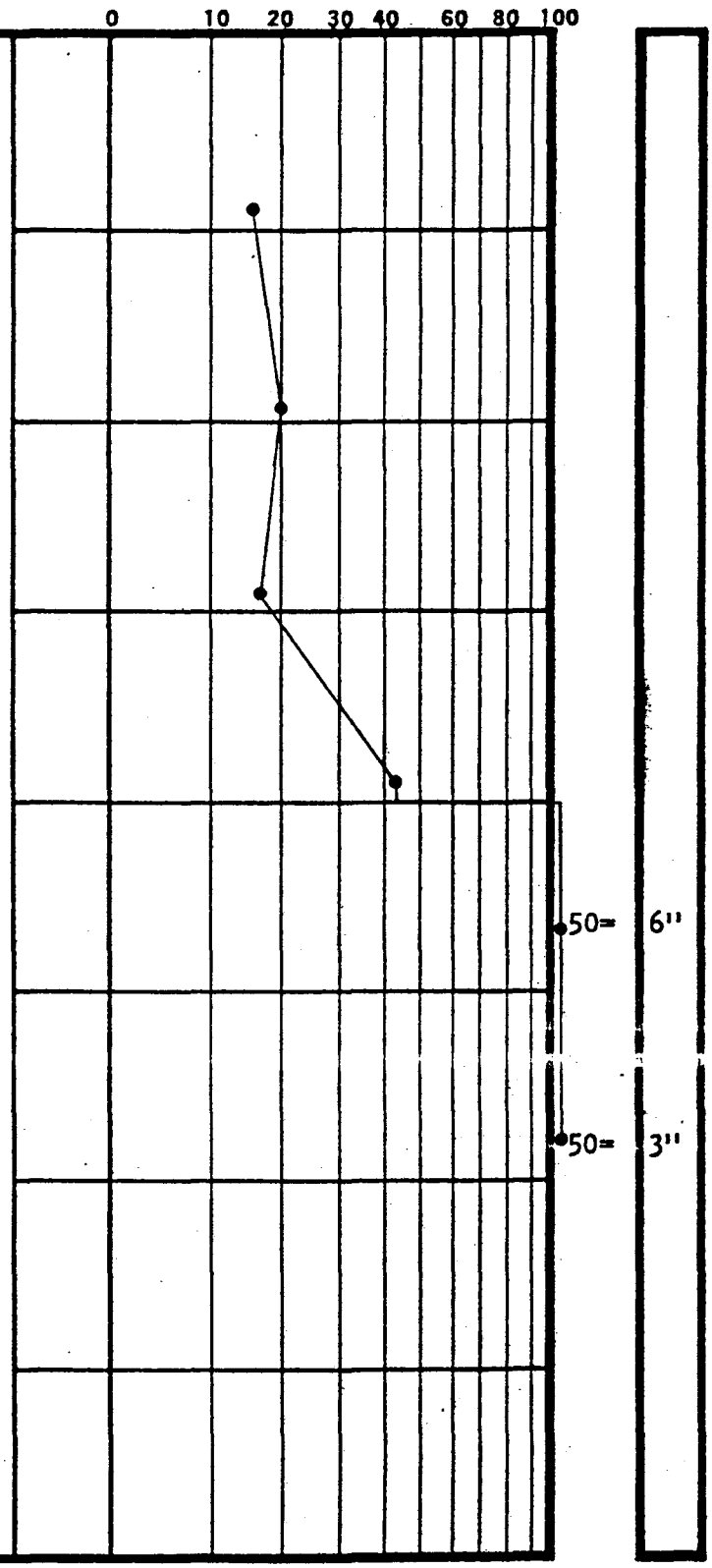
DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	(Residual) Firm Tan Brown Micaceous Silty Fine to Medium Sand
.0	Dense Green Brown Micaceous Silty Fine to Coarse Sand
.0	Partially Weathered Rock Sampled As Green Brown to Blue Gray And Tan Micaceous Silty Fine to Coarse Sand
)	Auger Refusal At 31.0 Feet Boring Terminated At 31.0 Feet No Groundwater Encountered At Time of Boring



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

ENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-10

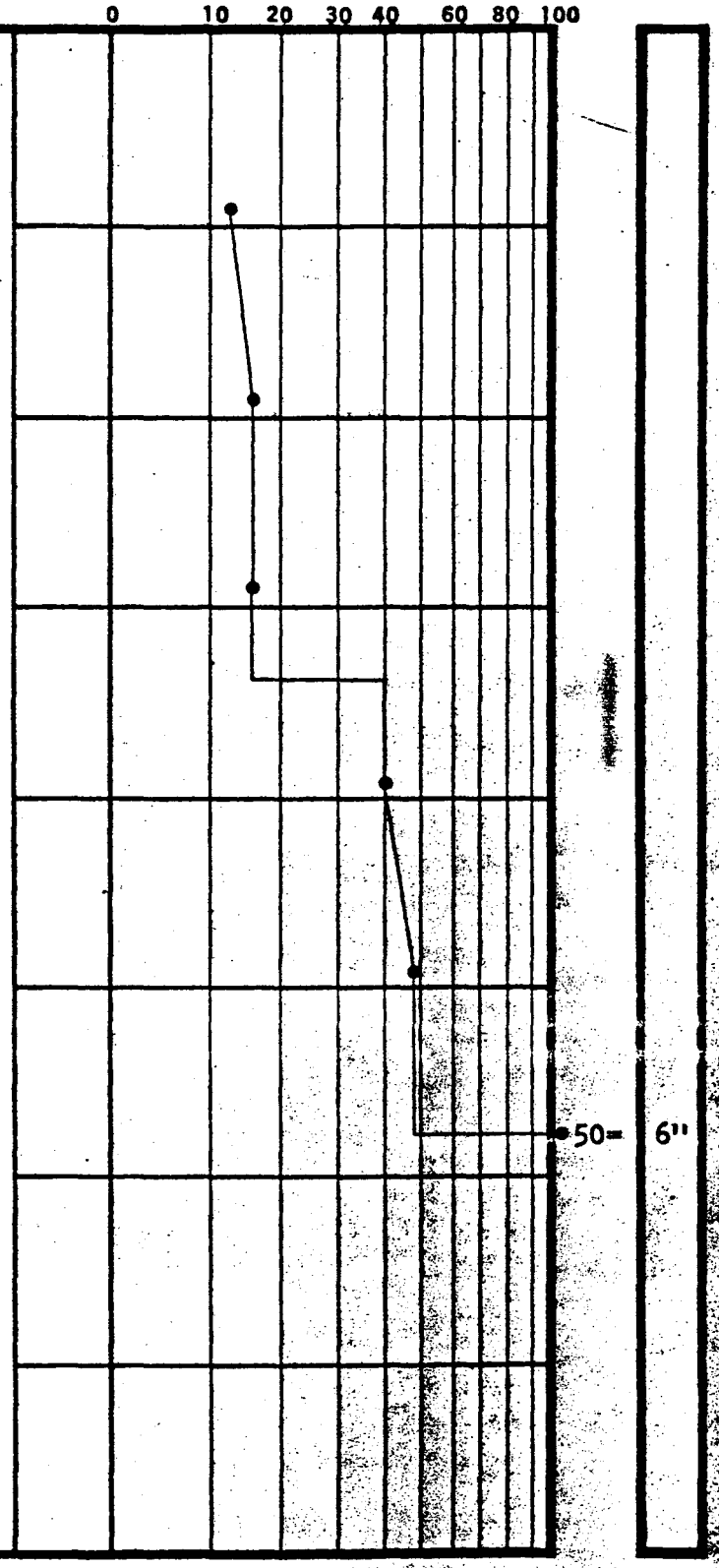
DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	(Residual) Stiff Tan Brown Micaceous Fine Sandy Silt
5.5	Firm Tan Brown And Green Gray Micaceous Silty Fine to Coarse Sand With Weathered Rock Fragments
17.0	Dense Blue Gray, Brown And White Micaceous Silty Fine to Medium Sand With Weathered Rock Fragments
29.0	
29.5	Boring Terminated At 30.0 Feet No Groundwater Encountered At Time of Boring *Partially Weathered Rock Sampled As Blue Gray Silty Fine to Medium Sand



BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-11

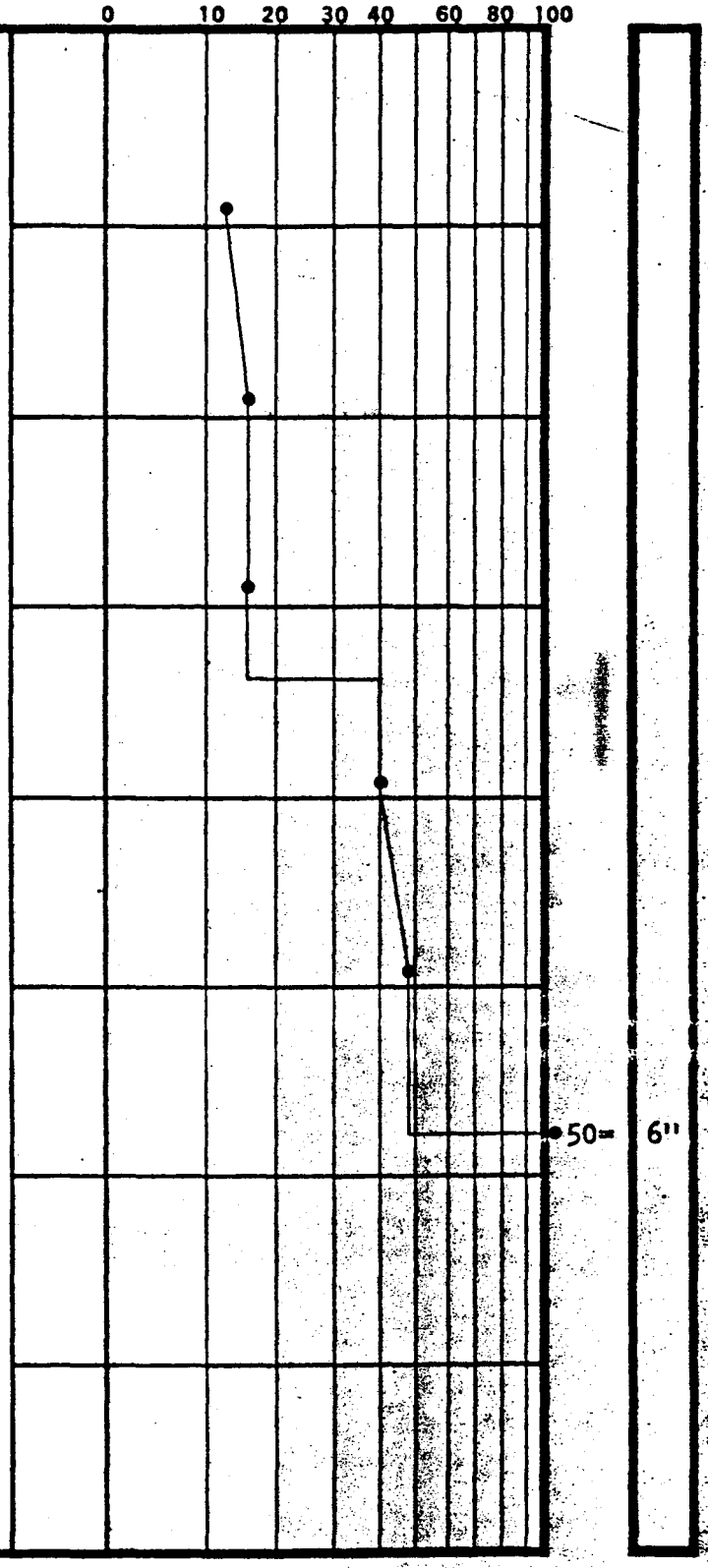
DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	(Residual) Stiff Tan Brown Micaceous Fine Sandy Silt
5.5	Firm Tan Brown And Green Gray Micaceous Silty Fine to Coarse Sand With Weathered Rock Fragments
17.0	Dense Blue Gray, Brown And White Micaceous Silty Fine to Medium Sand With Weathered Rock Fragments
29.0	*
29.5	Boring Terminated At 30.0 Feet No Groundwater Encountered At Time of Boring *Partially Weathered Rock Sampled As Blue Gray Silty Fine to Medium Sand



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-11

DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

LAW ENGINEERING TESTING COMPANY

Geotechnical and Materials Engineers

P.O. BOX 11297 501 MUDDET LANE CHARLOTTE NORTH CAROLINA 28220 / (704) 523-2022

August 22, 1980

Singer Furniture
P. O. Box 1588
Lenoir, North Carolina 28645

Attention: Mr. Eklain England
Project Manager

Subject: Report of Preliminary Geotechnical Exploration
Singer Furniture Facilities
Miller Hill Road (Virginia Street)
Lenoir, North Carolina
LETCo. Job No. CH 4467

Gentlemen:

As authorized by your Purchase Order No. 042345 dated August 7, 1980, Law Engineering Testing Company has completed a preliminary geotechnical exploration at the subject site. The purpose of this exploration was to generally define the range of subsurface conditions within the subject property and to determine its geotechnical suitability for future development. This report describes the work performed and presents the results obtained, along with our preliminary evaluation and recommendations.

Previously, we performed a preliminary geotechnical exploration at the site which included some borings within the current area. This previous work was reported as Law Engineering Job No. CH 4155 dated October 17, 1978.

SITE AND PROJECT INFORMATION

The Singer Furniture facilities are located south of Morganton Boulevard on both sides of Miller Hill Road (Virginia Street) in Lenoir, North Carolina. The total site encompasses between 60 and 70 acres. About one-half of this area lies in the moderately wooded flood plain of Lower Creek which runs along

the north boundary of the site. The extreme southern portion of the site has a moderately to steeply sloping topography and rises to as high as 75± ft above the existing Plant No. 3 facility. Part of this higher area has been used as a source for borrow material and is relatively clear. The undisturbed higher part is densely wooded.

Future site development plans call for plant expansion both to the north, within the present flood plain area, and to the south in the present high ground area. Anticipated future construction will be similar to existing site buildings. Approximately 10 ft of fill would be required within the flood plain area to obtain an elevation compatible with the predicted 100-year flood elevation of 1076 feet. South of the existing Plant Nos. 3 and 4, excavation depths ranging from 30 to 70 ft would be required to obtain the finished floor elevation of 1095 ft in Plant No. 3. Borrow soil excavated from this latter area would be available for use in filling in the flood plain area.

Our understanding of the proposed project plan is based on a meeting between our Mr. Jon Gould and Mr. Eklain England of Singer Furniture on July 25, 1980 and the furnished City of Lenoir topographic site plan.

FIELD EXPLORATION

Five soil test borings, designated BB-1 through BB-5 were drilled within the flood plain area. Three borings with infrequent split-spoon sampling, along with one offset auger boring, were drilled within the higher ground area south of existing Plant Nos. 3 and 4. The approximate boring locations are shown on the attached Boring Location Plan which we prepared from the furnished City of Lenoir Topographic Sheet B-5. The boring locations were mutually agreed upon by our Mr. Jon Gould and Mr. Eklain England of Singer Furniture. The borings were field-located by our drill crew by measuring from existing site features with a 100-ft tape, using estimated right angles. Elevations at the boring locations were estimated by interpolating between the ground surface elevation contours (contour interval of 5 ft) shown on the furnished topographic site plan.

The borings were made by both a rotary wash drilling procedure in which clear water was maintained in the borehole to stabilize the soils and by mechanically twisting a continuous steel flight auger into the soil. At regular intervals in the soil test borings and at infrequent intervals in the other borings, the drilling tools were removed and soil samples obtained with a standard 1.4-inch I. D., 2-inch O. D., split-tube sampler. Soil sampling and penetration testing were performed in general accordance with ASTM D 1586. The sampler was first seated 6 inches to penetrate any loose cuttings, then driven an additional 12 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final 12

inches was recorded and is designated the "penetration resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the laboratory. In the laboratory, the samples were examined by a geotechnical engineer to verify the driller's field classifications. Test Boring Records are attached, showing the soil descriptions and penetration resistances.

SUBSURFACE CONDITIONS

Area Geology

The project site is located in the Piedmont Physiographic Province, an area underlain by ancient igneous and metamorphic rocks. The virgin soils encountered in this area are the residual product of in-place chemical weathering of rock which was similar to the rock presently underlying the site. The typical residual soil profile consists of clayey soils near the surface where soil weathering is more advanced, underlain by sandy silts and silty sands. The boundary between soil and rock is not sharply defined. This transitional zone termed "partially weathered rock" is normally found overlying the parent bedrock. Partially weathered rock is defined, for engineering purposes, as residual material with standard penetration resistances in excess of 100 blows per foot. Weathering is facilitated by fractures, joints and by the presence of less resistant rock types. Consequently, the profile of the partially weathered rock and hard rock is quite irregular and erratic, even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and zones of partially weathered rock within the soil mantle, well above the general bedrock level.

Quite often, the upper soils along drainage features and in flood plain areas are water-deposited (alluvial) materials that have been eroded and washed down from adjacent higher ground. These alluvial soils are usually soft and compressible, having never been consolidated by pressures in excess of their present overburden.

Soil Conditions in Flood Plain

Within the flood plain area of the site, borings BB-4 and BB-5 encountered man-made fill to depths of 4 ft and 1 ft, respectively. The fill encountered in BB-5 (some of which was placed for access) and the upper 1 ft of fill in BB-4 consists of silty sand and gravel. Some wood chips and trash were present in the fill at BB-5. The deeper fill in BB-4 to 4 ft depth consists

of firm silty sand which is relatively clean. Boring BB-1 encountered material to 3 ft depth described as fill or possible alluvium consisting of very loose silty sand.

Below the fill or possible alluvium in borings BB-1, BB-4 and BB-5 and below a surficial topsoil cover in borings BB-2 and BB-3, alluvial materials were encountered to depths ranging from 14 ft in BB-1 to 33.5 ft in BB-5. The alluvium consists of very soft to soft sandy clayey silt and sandy silty clay and very loose to firm silty sand. The upper 18 to 20 ft of alluvium in borings BB-4 and BB-5 and the entire depth of alluvium in BB-1 consists primarily of fine-grained silty clay and clayey silt. This fine-grained alluvium is underlain in borings BB-4 and BB-5 by about 12 ft of alluvial silty sand. The alluvium encountered in borings BB-2 and BB-3 consists predominantly of silty sand for its full depth. The sampled alluvium typically contains decayed organics and wood fragments. The bottom few feet of the alluvium is typically very sandy and contains rounded gravel and small cobbles.

Below the alluvium in these five borings, residual soils resulting from the in-place chemical weathering of parent rock were encountered. The residual soils consist of firm to very dense silty sands which are generally micaceous. Residual material hard enough to be termed partially weathered rock was encountered in borings BB-1, BB-2 and BB-3 slightly above boring termination at depths ranging from 33 to 34 feet.

South of Plant Nos. 3 and 4

Current borings BB-6, BB-7, BB-7A and BB-8 encountered subsurface conditions similar to those encountered by previous soil test borings B-10 and B-11 located within this site area. Previous borings B-10 and B-11 encountered residual soils from the ground surface consisting of stiff micaceous sandy silt and firm to dense silty sand to respective depths of 20 and 29 feet. Partially weathered rock was encountered below these depths to auger refusal at 31 ft in B-10 and to boring termination at 29.5 ft in B-11.

Residual soils consisting of sandy silts and silty sands, with estimated consistencies ranging from loose to very dense, were encountered in borings BB-6 through BB-8 to depths ranging from 39.5 ft in BB-7 to 57.5 ft in BB-8. The residual soils are typically micaceous with the percentage of mica variable with depth and location. Partially weathered rock was encountered at approximate depths of 55 ft in BB-7A and 57.5 ft in BB-8. The depth of partially weathered rock in these borings is very approximate and is based primarily on the driller's assessment of drilling difficulty, along with infrequent split-spoon sampling. Refusal to mechanical augers was encountered at 39.5 ft in BB-7 and refusal to rotary drag bit was encountered at 63.1 ft in BB-7A. Boring BB-7A is located approximately 25 ft south of BB-7 and was drilled to help determine the lateral extent of the relatively shallow refusal material encountered in BB-7. Refusal to the soil drilling equipment may

result from hard rock lenses, pinnacles, boulders or the upper surface of sound continuous rock. Diamond core drilling procedures would be required to penetrate and retrieve samples in order to determine the nature and continuity of the refusal material. Diamond core drilling was not performed in these borings.

Groundwater Conditions

Water levels were checked in all the borings at the time of drilling and again in the majority of the borings after times ranging from 24 hours to several days, to record the stabilized groundwater levels. In the flood plain area, stabilized groundwater levels ranged from 1 to 6 ft in borings BB-1, BB-2 and BB-5. Groundwater was at 5 ft in BB-3 several hours after completion of drilling and at a similar depth in boring BB-4 at the completion of drilling. Only limited groundwater information was obtained in borings BB-6 through BB-8. Groundwater was at 32.5 ft in BB-6 after several days, which corresponds to approximately elevation 1105 feet. After 24 hours, boring BB-7 was dry and caved at 34 feet. Such caved depths are often indicative of groundwater slightly below the caved depth. However, caving of boreholes can also be caused by fall-in or collapse of the walls of the borehole well above the groundwater level, which is likely in this case. Water levels in borings BB-7A and BB-8 were noted at the time of boring but are unreliable since water was used in advancing these boreholes. These borings were not checked for stabilized groundwater. Previous borings B-10 and B-11 were dry to the termination depths at the time of boring. The significant depth of excavation which has been performed south of Plant No. 3 has undoubtedly depressed the groundwater level within the high ground portion of the site below its level before excavation.

Groundwater levels may fluctuate several feet with seasonal rainfall variations and with changes in the water level in adjacent streams. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

Details of the subsurface conditions encountered in the recent borings and previous borings B-10 and B-11 are presented on the attached Test Boring Records. A summary of the subsurface conditions encountered in these borings is given on the attached Table I.

PRELIMINARY EVALUATION AND RECOMMENDATIONS

Flood Plain Area

The man-made fill and alluvium encountered in borings BB-1 through BB-5 is not suitable for support of buildings. Foundations bearing in such potentially highly compressible material would be subject to excessive amounts of total and differential settlement. Two possible alternatives to provide suitable structural support in this area are discussed below.

TABLE
SUMMARY OF SUBSURFACE CONDITIONS
LETCo. JOB NO. CH 4467

Boring No.	Approx. Surface Elev.(1) (Ft)	Approx. Depth of Fill (Ft)	Approx. Depth of Alluvium (Ft)	Approx. Depth to PWR (Ft)	Approx. Depth to Refusal(2) (Ft)	Approx. Groundwater Depth(3) (Ft)
BB-1	1070±	3	14	34	--	1
BB-2	1068	--	29	33.5	--	6
BB-3	1067	--	29.5	33	--	5
BB-4	1070	4	34.5	--	--	5 @ TOB
BB-5	1068	1	33.5	--	--	5
BB-6	1137	--	--	--	--	32.5
BB-7	1167	--	--	--	39.5	Caved & Dry @ 34
BB-7A	1165	--	--	55	63.1	--
BB-8	1160	--	--	57.5	--	--
BB-10	1125(4)	--	--	20	31	--
BB-11	1135(4)	--	--	29	--	--

Notes: (1) Surface Elevations Estimated by Interpolation Between Surface Contours Shown on Furnished City of Lenoir Topographic Map.

(2) Refusal May Represent Boulders, Hard Rock Lenses or the Upper Surface of Bedrock.

(3) Groundwater Depths Represent Measurements Made After a Reasonable Stabilization Period Except Where Indicated as TOB (Time of Boring).

(4) Surface Elevation at Previous Boring Estimated from Recently Furnished City of Lenoir Topographic Map.

DUNCAN-PARNELL, INC., CHARLOTTE 280

One possible alternative would be foundation support on compacted structural fill placed above the existing flood plain surface. A sufficient thickness of fill, probably on the order of 10 ft, would be required between the bottom of foundations and the existing alluvial materials to contain significant foundation stresses within the fill. This depth of fill would seem compatible with existing site grade since approximately 10 ft of fill would be required in the flood plain area to obtain the predicted 100-year flood elevation. Construction on top of the fill would have to be delayed until sufficient time had elapsed for the alluvium to adjust to the weight of this fill and for the fill to have adjusted to its own weight. Due to the clayey nature of much of the alluvium, several months would likely be required for this adjustment to occur. Laboratory consolidation testing on undisturbed samples of the alluvium would be required to predict the time necessary for settlement adjustment to occur. Settlement plates installed at the base of the fill and monitored regularly by precision leveling, both during and following the filling operation, would be required to determine when settlements were negligible. Even after this period of settlement adjustment, additional long term "secondary settlement" would continue. The magnitude of this secondary settlement would have to be determined from laboratory consolidation testing of undisturbed samples of this material. Provided that primary settlement was completed and sufficient fill thickness separated the building foundations and underlying alluvium, such long term secondary settlements would likely be negligible. This would have to be confirmed by the laboratory testing program.

Construction on top of the completed fill would impose additional stresses in the fill due to the floor and foundation loads. Provided that the alluvium and fill had previously adjusted to the weight of overlying material, settlements due to the new construction would likely be within the range for typical plant construction. However, heavy floor or column loads could experience undesirable magnitudes of settlement. Such settlements could be minimized by preloading above the proposed subgrade level of compacted structural fill with several feet of uncompacted fill to allow the fill soils to adjust to a loading roughly equivalent to future building loads.

If time is not available for settlements to occur prior to actual building construction, then deep foundations would be required to transfer the structural loads through the compressible alluvial soils to the underlying relatively incompressible residual soil and partially weathered rock. In our opinion, a deep foundation system of driven piles consisting of timber, closed-end, concrete-filled steel pipe piles or steel H-piles, would be feasible. Such piles would derive support primarily from end bearing with some contribution from skin friction in the residual soils and partially weathered rock below the alluvium. Predrilling through the gravel and cobble layer at the base of the alluvium would be required for use of timber piles. Based on the available limited subsurface information, we anticipate maximum allowable working capacities of 20 to 25 tons for timber piles bearing in very

dense residual soil or on partially weathered rock and 50 to 60 tons for closed-end, concrete-filled steel pipe piles extended a few feet into partially weathered rock. The borings indicate that required depths for the timber and pipe piles would likely range from 35 to 40+ feet. The feasibility for use of timber piles would largely depend on the depth of additional fill to be placed above the present flood plain surface, since the maximum length of timber piles readily obtainable is on the order of 60 feet. Steel H-piles driven several feet into partially weathered rock could potentially achieve up to 100 tons of individual working capacity. Additional borings extended to greater depth would be required to more accurately predict pile loads and pile tip elevations.

Even if driven piles were utilized for support of structural loads, it would still be desirable to allow time for the alluvium to adjust to the weight of any fill placed to raise site grade in the flood plain area. Piles installed through the fill and alluvium before such adjustment had occurred would be subject to negative skin friction forces caused by settlement of the fill and alluvium adjacent to the piles. Such negative or downdrag forces would reduce the available working capacity of the piles for structural support. Also, if fill settlement was not allowed to occur prior to construction, floor slabs would have to be pile supported and designed as structural slabs.

Area South of Plant Nos. 3 and 4

The previous and current borings drilled within this area indicate that the surface of partially weathered rock and hard rock is knobby and uneven, as is characteristic of this geologic area. Residual soils with standard penetration resistances of 60 or less can generally be excavated with conventional earthmoving equipment. Harder residual soils and partially weathered rock typically require heavy excavating equipment with ripping tools for efficient excavation. Refusal materials, where continuous, generally require blasting for efficient excavation. Thus, the borings indicate that conventional excavation could be accomplished to depths ranging from about 20 to 57 ft below existing grade, corresponding to a range in elevation from about 1092 (boring termination in BB-6) to 1128 feet. Ripping of partially weathered rock and blasting of refusal materials present below these depths would be required. Some random boulders, ridges or pinnacles of rock requiring blasting would likely be encountered within the general depths of conventional excavation. (Hard rock which required blasting is exposed in the face of the cut south of Plant No. 3.)

Although the groundwater level will likely be permanently depressed as the large, deep excavation is made, some dewatering and drainage will probably be required. Adequate groundwater control could likely be achieved by gravity drainage and pumping from strategically placed, filtered sumps.

Based on the results of the previous and current borings, we anticipate that bearing pressures for shallow foundations ranging from 5000 psf in residual soil up to 10,000 psf in partially weathered rock would be generally available. Much higher bearing pressures are possible on hard, intact rock. These bearing pressures would have to be verified by additional soil test borings drilled within specific building locations after excavation is completed.

Laboratory classification and compaction testing was not within the scope of this preliminary exploration. However, our visual examination of the split-spoon samples and previous experience with similar materials indicate that the proposed cut materials would in general be suitable for use as structural fill. Some of the proposed cut materials contain a significant percentage of mica. Strict moisture control of such material would likely be required to minimize potential "fluffing" during compaction in order to achieve desired density. Partially weathered rock should not be used for structural fill unless it can be broken down by the excavation and compaction equipment into a material with maximum particle size of 6 inches. The sandy nature of the partially weathered rock at this site is favorable in this regard. In general, soils to be used as structural fill in building and pavement areas should have a Plasticity Index less than 30 (15 is ideal) and should have less than 5 percent (by weight) of fibrous organic material.

Before filling commences, a representative sample of each proposed fill material should be tested to determine its compaction characteristics, including maximum dry density and optimum moisture content.

QUALIFICATION OF REPORT

Our evaluation of foundation support and excavation conditions for this preliminary subsurface exploration has been based on our understanding of the project and site information and the data obtained in our exploration. The general subsurface conditions utilized in our evaluation of foundations are based on interpolation of subsurface data between the widely spaced borings. In evaluating the boring data obtained in this preliminary subsurface exploration, we have examined previous correlations between penetration resistances and foundation bearing pressures observed in soil conditions similar to those at your site.

The foundation recommendations stated in this report are only preliminary in nature and not intended for use in final foundation design. When the project plans are finalized, we will be glad to work with you in establishing the final investigative program required to give detailed soil and rock-related recommendations for foundation design and site preparation.

Law Engineering Testing Company appreciates the opportunity to provide our geotechnical engineering services on this project. If you have any questions concerning this report or if we may be of further assistance to you during the final design and construction phases plant expansions, please contact us.

Very truly yours,

LAW ENGINEERING TESTING COMPANY

Mel Y. Browning

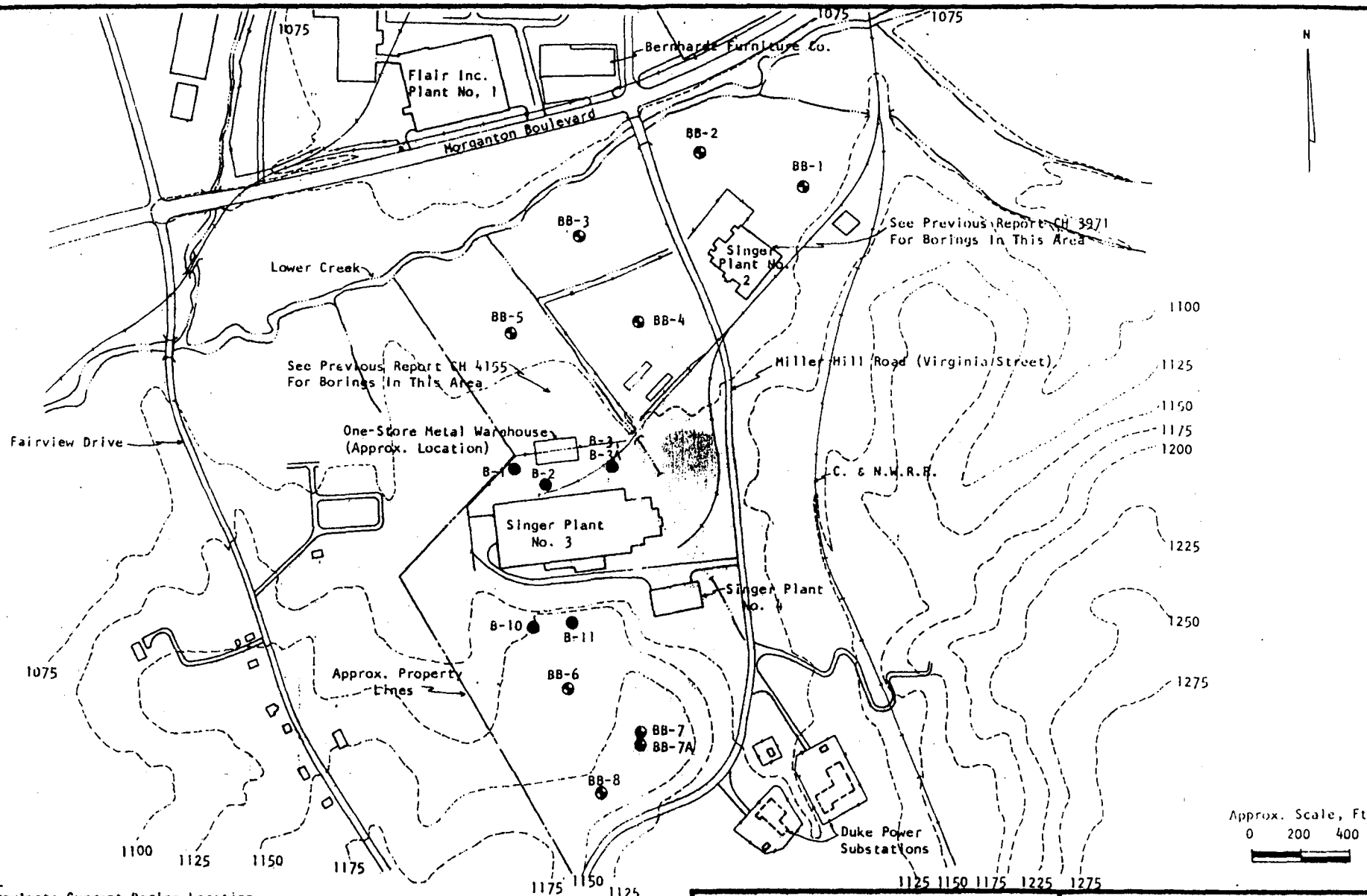
Mel Y. Browning, P. E.
Project Soils Engineer
Registered, N. C. 8696

Jon H. Gould

Jon H. Gould, P. E.
Chief Engineer
Registered, N. C. 7582

MYB/JHG/tmc

Attachments



LEGEND

- Approximate Current Boring Location
- Approximate Previous Boring Location (CH 4155)
- Existing Ground Surface Elevation Contour

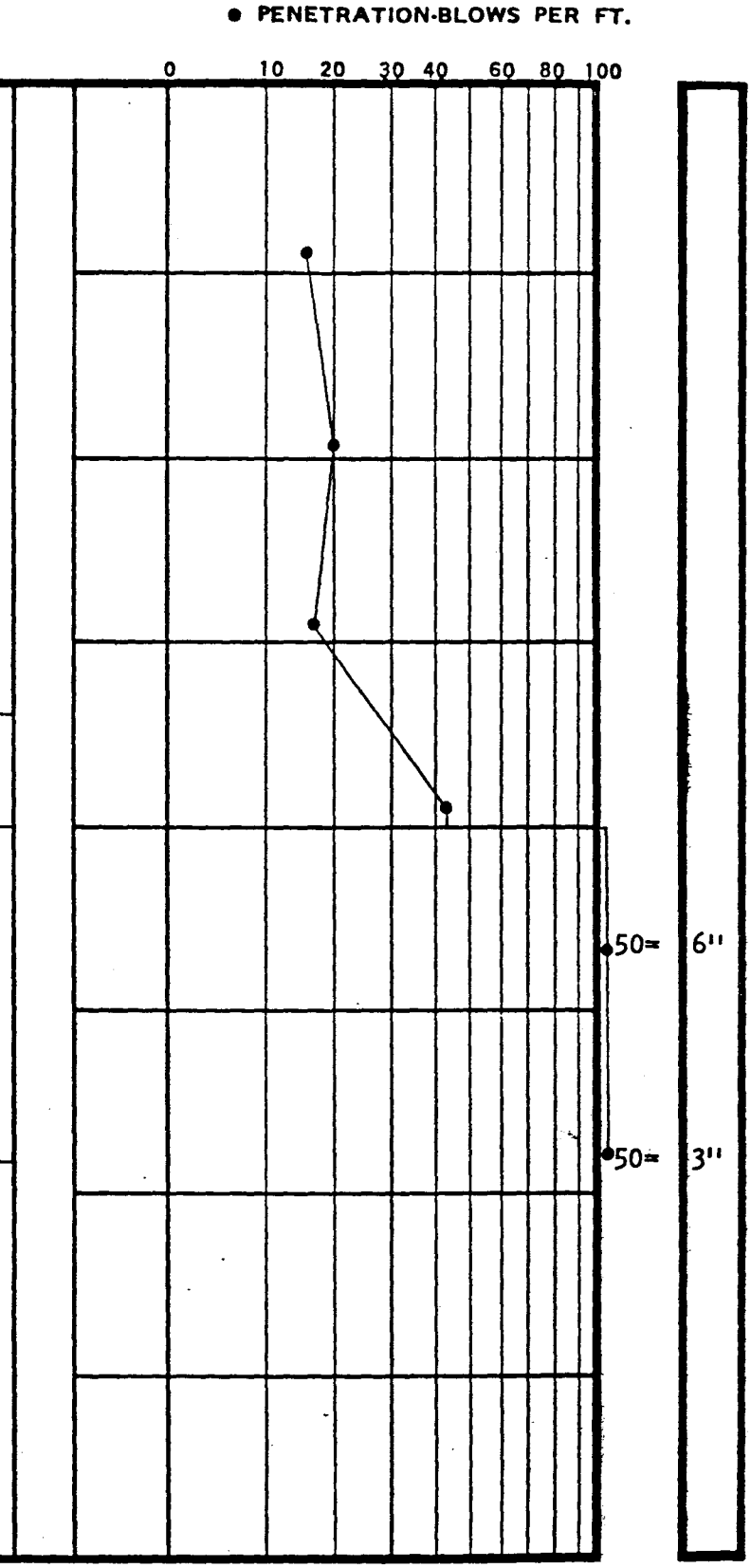
LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

Singer Furniture
Lenoir, North Carolina

Boring Location Plan
Singer Furniture Facilities
Miller Hill Road (Virginia Street)
Lenoir, North Carolina

DWN BY	DAM		SCALE: Shown
CKD. BY	MYB		DRAWING NO. 1
APPR'D.	JHG		CH 4467

DEPTH FT.	DESCRIPTION
	(Residual) Firm Tan Brown Micaceous Silty Fine to Medium Sand
.0	Dense Green Brown Micaceous Silty Fine to Coarse Sand
.0	Partially Weathered Rock Sampled As Green Brown to Blue Gray And Tan Micaceous Silty Fine to Coarse Sand
0	Auger Refusal At 31.0 Feet Boring Terminated At 31.0 Feet No Groundwater Encountered At Time of Boring



BORING AND SAMPLING MEETS ASTM D-1586
IE DRILLING MEETS ASTM D-2113

..NETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-10

DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100	
	(Residual) Stiff Tan Brown Micaceous Fine Sandy Silt		
	Firm Tan Brown And Green Gray Micaceous Silty Fine to Coarse Sand With Weathered Rock Fragments		
	Dense Blue Gray, Brown And White Micaceous Silty Fine to Medium Sand With Weathered Rock Fragments		
	*	● 50=	6"
	Boring Terminated At 30.0 Feet No Groundwater Encountered At Time of Boring *Partially Weathered Rock Sampled As Blue Gray Silty Fine to Medium Sand		

BORING AND SAMPLING MEETS ASTM D-1586
RE DRILLING MEETS ASTM D-2113

ETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-11

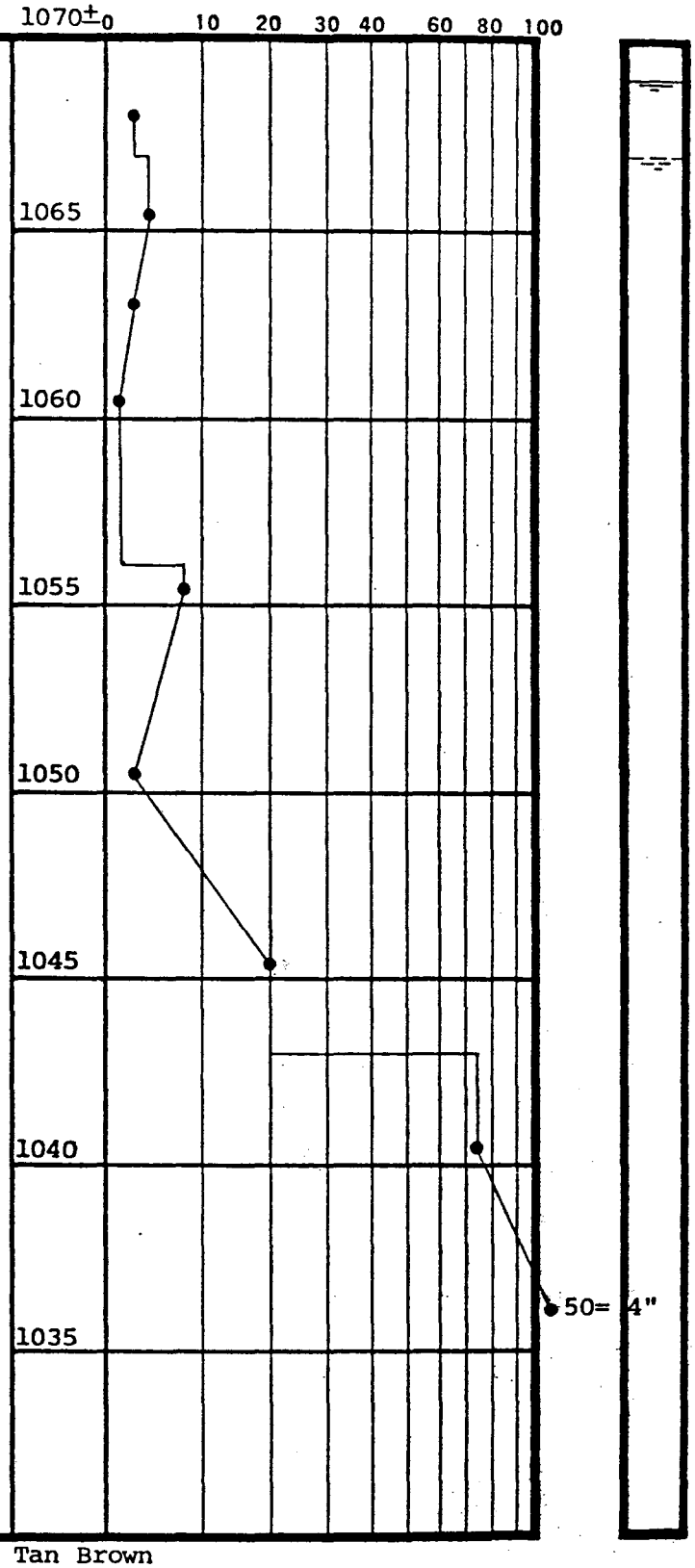
DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
	(Fill or Possible Alluvium) Very Loose Gray Black Brown Micaceous Silty Fine to Coarse Sand	1070±
3.0	(Alluvium) Firm to Soft Blue Black Silty Clay With Wood Fragments and Decayed Organics	1065
3.0	(Alluvium) Very Soft Blue Black Fine to Medium Sandy Clayey Silt With Decayed Organics and Coarse Sand and Gravel from 13.5 to 14 Feet	1060
.0	(Residual) Loose Tan Brown Micaceous Clayey Silty Fine to Coarse Sand With Weathered Rock Fragments to Very Loose Tan Micaceous Silty Fine to Coarse Sand	1055
		1050
	Firm Tan Brown Micaceous Silty Fine to Coarse Sand	1045
.0	Very Dense Mottled Gray, Tan and White Micaceous Silty Fine to Medium Sand	1040
.0	*	
.3	Boring Terminated at 34.3 Feet	1035
	Groundwater at 3 Feet at Time of Boring	
	Groundwater at 1 Foot on 8/13/80	



*Partially Weathered Rock Sampled As Green Tan Brown Micaceous Silty Fine to Coarse Sand

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-1

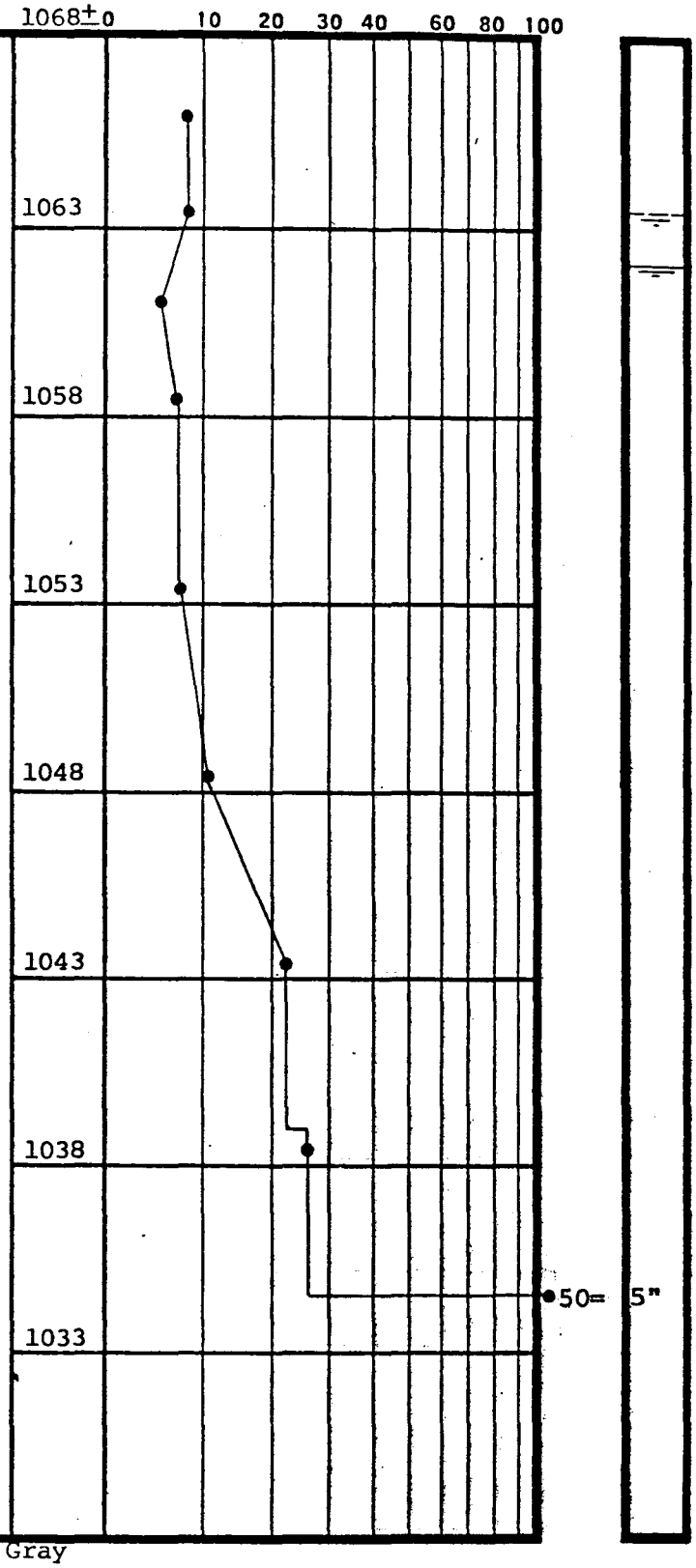
DATE DRILLED 8/8/80

JOB NO. CH 4467

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1068±
0	Weeds and Topsoil	
	(Alluvium) Firm Gray Tan Brown Slightly Micaceous Fine Sandy Silt	
3.0	(Alluvium) Loose Blue Tan Gray Micaceous Silty Fine to Medium Sand With Wood Fragments	1063
		1058
		1053
.0	(Alluvium) Firm Tan Blue Gray Micaceous Silty Fine to Medium Sand With Coarse Sand and Rounded Gravel at 28.5 Feet	1048
		1043
.0	(Residual) Firm Green and White Micaceous Silty Fine to Medium Sand	1038
.5	*	
.9	Boring Terminated at 33.9 Feet	1033
	Groundwater at 4.5 Feet at Time of Boring	
	Groundwater at 6 Feet on 8/13/80	



*Partially Weathered Rock Sampled as Blue Gray and White Silty Fine to Coarse Sand

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

ENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-2

DATE DRILLED 8/7/80

JOB NO. CH 4467

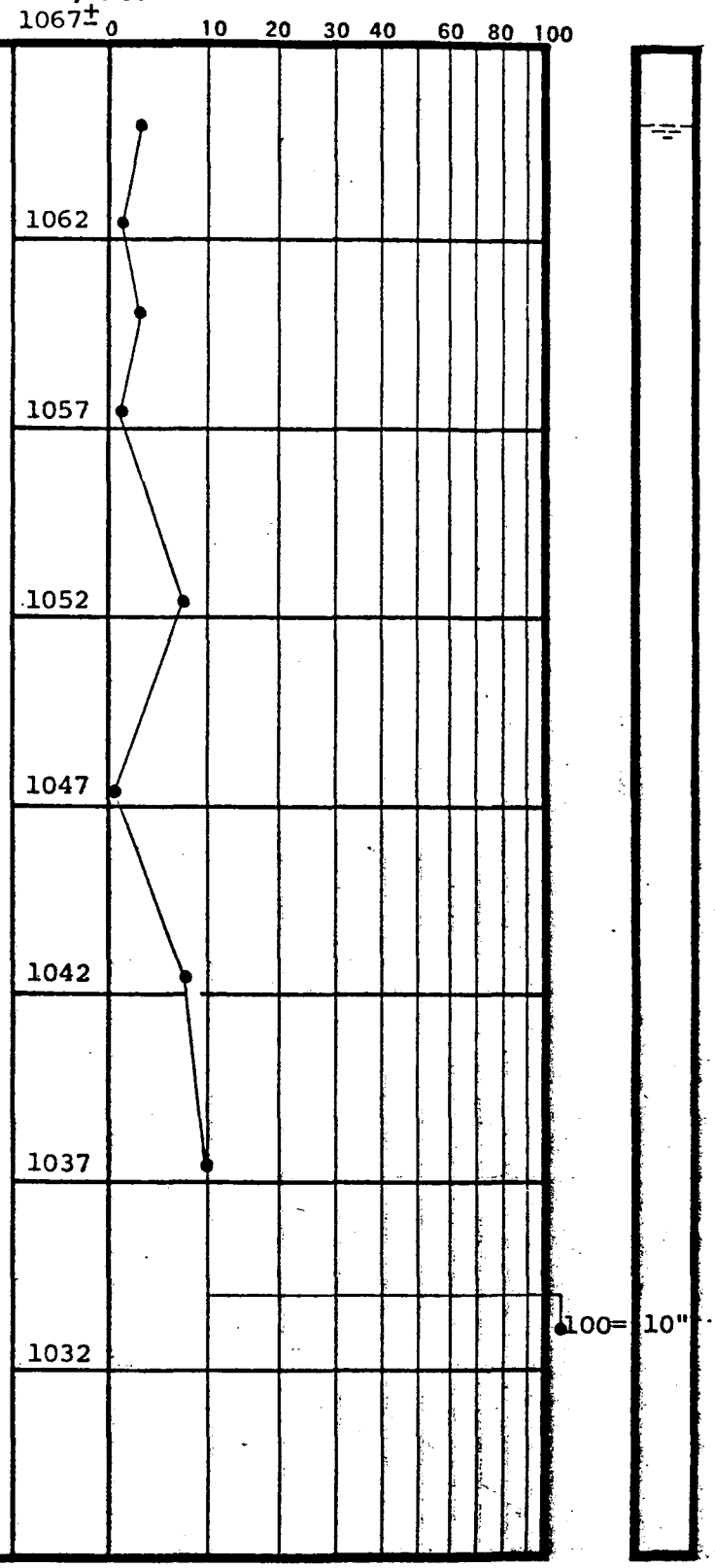
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1067±
0	(Alluvium) Soft to Very Soft Tan Brown to Gray Tan Micaceous Clayey Fine Sandy Silt	1062
5.5	(Alluvium) Very Loose to Loose Tan Blue Gray Micaceous Silty Fine to Medium Sand With Decayed Organics	1057
		1052
7.0	(Alluvium) Very Loose Tan Blue Gray Micaceous Silty Fine Sand to Loose Tan Blue Gray Micaceous Silty Fine to Coarse Sand With Rounded Gravel Below 26.5 Feet	1047
		1042
9.5	(Residual) Loose Green and White Micaceous Silty Fine to Medium Sand	1037
13.0	Partially Weathered Rock Sampled As Green Brown and White Silty Fine**	
34.3	Boring Terminated at 34.3 Feet	1032

Groundwater at 2 Feet at Time of Boring and 5 Feet After Several Hours

*Topsoil
**to Coarse Sand



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

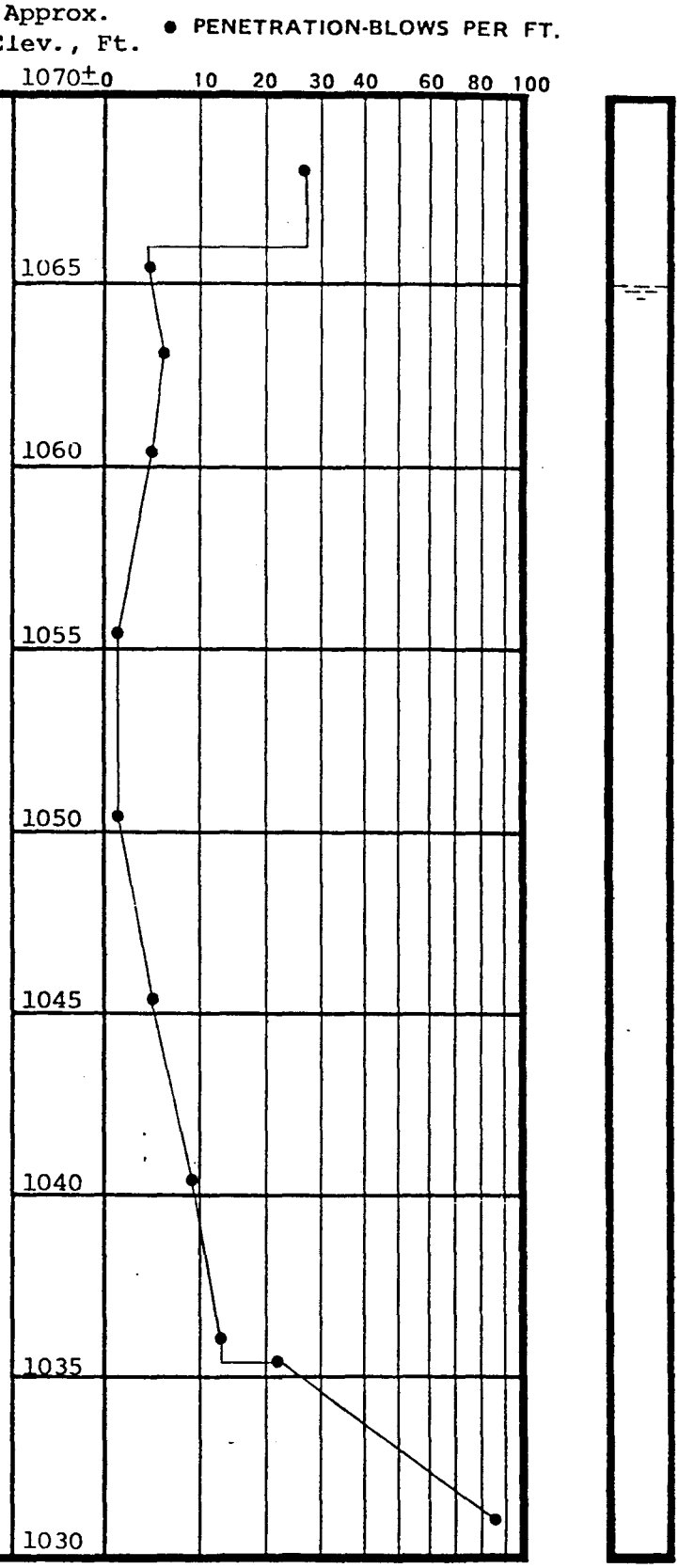
UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-3
DATE DRILLED 8/12/80
JOB NO. CH 4467
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
0	(Fill) Gravel and Soil Mixture
	(Fill) Firm Brown Micaceous Silty Fine to Medium Sand
4.0	(Alluvium) Firm Blue Gray Micaceous Fine to Medium Sandy Silty Clay to Fine Slightly Sandy Silty Clay
12.0	(Alluvium) Very Soft Blue Gray Micaceous Fine Slightly Sandy Silty Clay With Silty Fine to Coarse Sand Seams
2[illegible]	(Alluvium) Loose Tan Blue Gray Micaceous Silty Fine Sand
28.5	(Alluvium) Loose to Firm Gray Tan Silty Fine to Coarse Sand With Rounded Gravel. Larger Gravel and Cobbles From 33.5 to 34.5 Feet
34.5	(Residual) Firm Tan Brown Micaceous Silty Fine to Medium Sand
38.5	Very Dense Tan Brown Silty Fine to Coarse Sand
40.0	



Boring Terminated a5 40.0 Feet Groundwater Encountered at 5 Feet at Time of Boring

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

'ENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

TEST BORING RECORD

BORING NO. BB-4

DATE DRILLED 8/8/80

JOB NO. CH 4467

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

UNDISTURBED SAMPLE

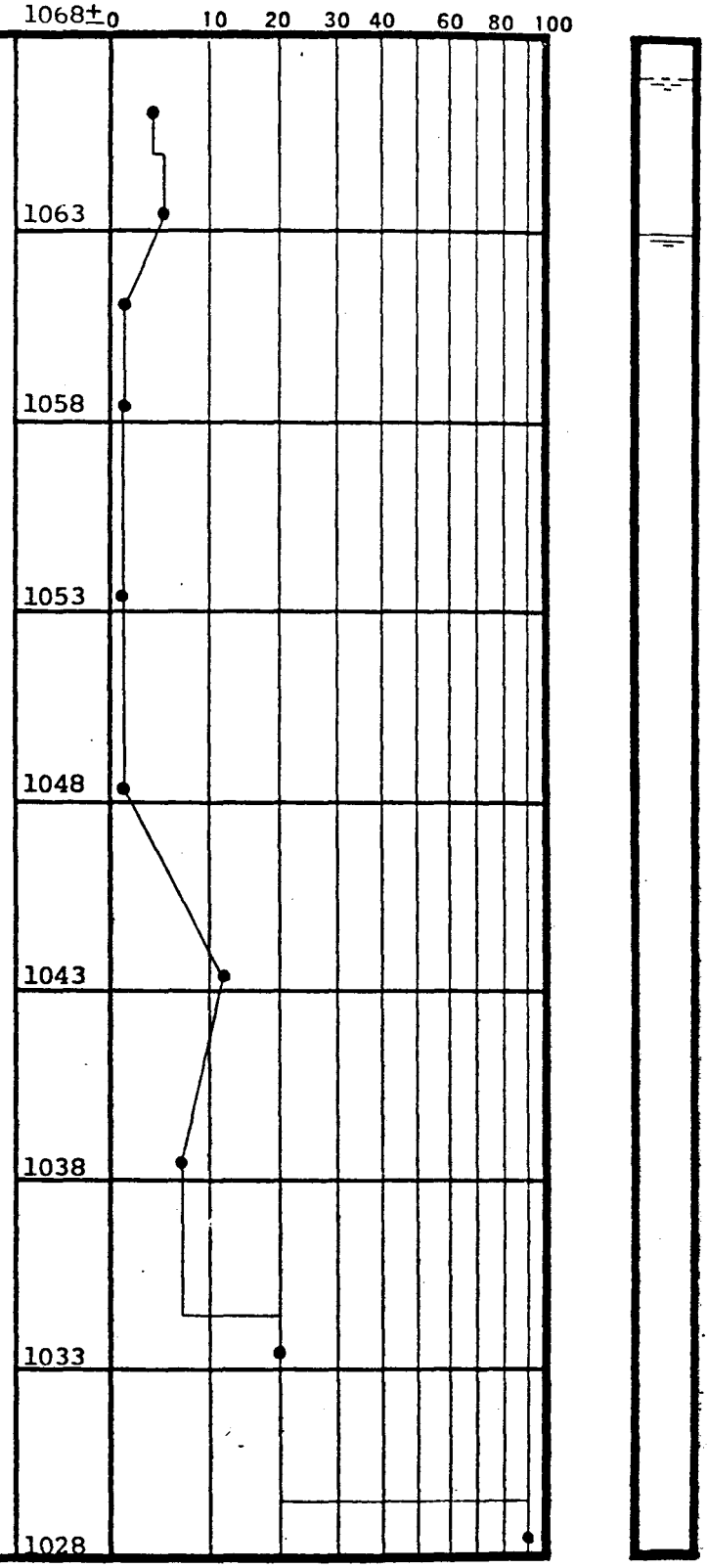
50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	(Fill) Tan Micaceous Silty Fine to Medium Sand With Wood Chips and Trash	1068±
	(Alluvium) Soft Gray Tan Brown Slightly Micaceous Fine Slightly Sandy Silt With Wood and Decayed Organics	
3.0	(Alluvium) Firm Tan Blue Gray Silty Clay	1063
5.0	(Alluvium) Very Soft Tan Blue Gray to Blue Gray Silty Clay	1058
		1053
		1048
20.0	(Alluvium) Firm Tan Brown Micaceous Silty Fine to Medium Sand to Loose Blue Tan Gray Micaceous Silty Fine to Medium Sand With Organics and Rounded Gravel Below 28.5 Feet	1043
		1038
33.5	(Residual) Firm Orange Tan to Gray, Green and White Micaceous Silty Fine to Medium Sand	1033
38.5	Very Dense Residual Soil (No Sample Recovery)	1028
40.0		



Boring Terminated at 40.0 Feet Groundwater at 1 Foot at Time of Boring

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

Groundwater at 5 Feet After 24 Hours

ENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

TEST BORING RECORD

BORING NO. BB-5

DATE DRILLED 8/12/80

JOB NO. CH 4467

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1137±	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Residual) Pink Brown Micaceous Silty Fine Sand to Tan Micaceous Fine to Medium Silty Sand (No Split-Spoon Samples Obtained - Soil Descriptions From Samples of Auger Cuttings)	1132	
		1127	
		1122	
15.0	Residual Soil Sampled as Dense Red Tan Brown Micaceous Silty Fine to Medium Sand From 18.5 to 20.0 Feet and Firm Gray Tan Brown Micaceous Silty Fine to Medium Sand From 43.5 to 45.0 Feet	1117	●
		1112	
		1107	
		1102	
40.0		1097	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

ENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-6

DATE DRILLED 8/7/80

JOB NO. CH 4467

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1097±	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
1.0	Residual Soil Sampled as Dense Red Tan Brown Micaceous Silty Fine to Medium Sand From 18.5 to 20.0 Feet and Firm Gray Tan Brown Micaceous Silty Fine to Medium Sand From 43.5 to 45.0 Feet	1092	●
45.0	Boring Terminated at 45.0 Feet Groundwater at 40.5 Feet at Time of Boring Groundwater at 32.5 Feet on 8/12/80		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-6

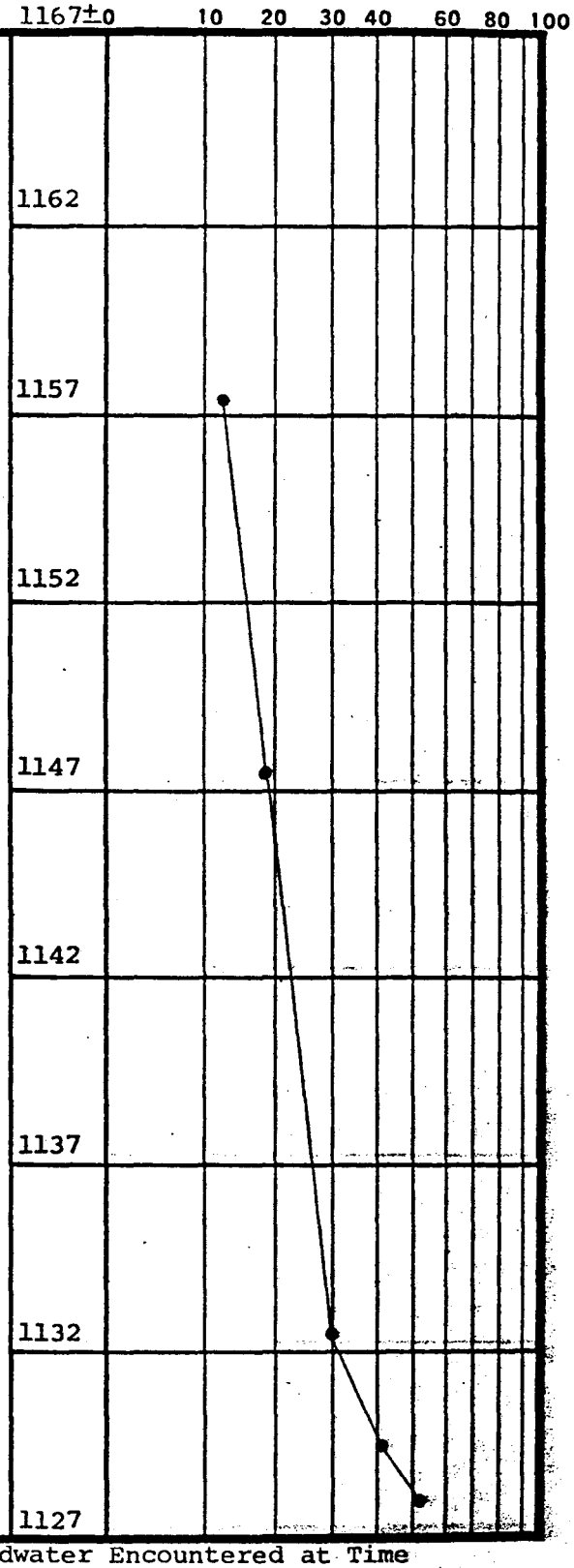
DATE DRILLED 8/7/80

JOB NO. CH 4467

PAGE 2 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0		1167±0
3"	Topsoil and Roots	
	(Residual) Red Brown Micaceous Slightly Clayey Fine to Medium Very Sandy Silt (No Split-Spoon Samples Obtained - Soil Description From Samples of Auger Cuttings)	1162
5.0	Firm Tan Brown Micaceous Silty Fine to Medium Sand to Fine to Coarse Sand	1157
		1152
		1147
		1142
		1137
		1132
36.0	Dense to Very Dense Tan White to Gray Tan White Silty Fine to Coarse Sand	
39.5	Refusal to Augers at 39.5 Feet	1127



*Boring Terminated at 39.5 Feet No Groundwater Encountered at Time of Boring Borehole Caved and Dry at 34 Feet After 24 Hours

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO: BB-7

DATE DRILLED 8/9/80

JOB NO. CH 4467

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Residual) Red Brown Micaceous Fine Sandy Silt With Loose to Firm Consistency, Based on Driller's Assessment of Drilling Difficulty (No Split-Spoon Samples Obtained)	1165±	
		1160	
		1155	
		1150	
15.0	Red Tan Brown Micaceous Silty Fine to Medium Sand With Firm Consistency, Based on Driller's Assessment of Drilling Difficulty (No Split-Spoon Samples Obtained)		
		1145	
		1140	
		1135	
		1130	
5.0	Tan Brown Micaceous Silty Fine to Medium Sand With Estimated Firm to Dense Consistency (No Split-Spoon Samples Taken)		
0.0		1125	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-7A

DATE DRILLED 8/11/80

JOB NO. CH 4467

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)	
0	Tan Brown Micaceous Silty Fine to Medium Sand With Estimated Firm to Dense Consistency (No Split-Spoon Samples Taken)	1125+		
		1120		
		1115		
52.0	Tan Brown Micaceous Silty Fine to Medium Sand With Estimated Very Dense Consistency	1110		
55.0	Partially Weathered Rock As Estimated by Driller	1105		
63.1	Refusal to Rotary Drag Bit at 63.1 Feet Boring Terminated at 63.1 Feet	1100	● 50=	0

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-7A

DATE DRILLED 8/11/80

JOB NO. CH 4467

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LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1160±	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Residual) Red Brown Micaceous Fine Sandy Silt With Loose Consistency, Based on Driller's Assessment of Drilling Difficulty (No Split-Spoon Samples Obtained)	1155	
		1150	
13.0	Red Tan Brown to Tan Brown Micaceous Silty Fine to Medium Sand With Firm Consistency Based on Split-Spoon Sample from 13.5 to 15.0 Feet and Driller's Assessment of Drilling Difficulty in Soils Below	1145	●
		1140	
		1135	
		1130	
		1125	
40.0		1120	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-8

DATE DRILLED 8/12/80

JOB NO. CH 4467

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LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	Red Tan Brown to Tan Brown Micaceous Silty Fine to Medium Sand With Firm Consistency Based on Split-Spoon Sample from 13.5 to 15.0 Feet and Driller's Assessment of Drilling Difficulty in Soils Below	1120±	
		1115	
		1110	
		1105	
57.5	Partially Weathered Rock Sampled As Green Tan Brown Micaceous Silty Fine to Coarse Sand	1100	
63.8	Boring Terminated at 63.8 Feet	1095	● 50= 3"

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-8

DATE DRILLED 8/12/80

JOB NO. CH 4467

PAGE 2 OF 2

LAW ENGINEERING TESTING COMPANY

SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

Location: The Singer Co-Lenoir County: Caldwell, N.C. Job No.: 4482-129 Boring or Well No.: S-

Logged by: C. Silkwood Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: ___

Date Started: 10/13/82 Boring Depth: 30 ft Static Water Level: 20.2 ft

Date Completed: 10/14/82 Well Depth: 30 ft Permeability Tests: none

Drilling Method: Auger Casing: 2-in PVC, Sch 80 Thrd, 0-25 ft

Development Method: Flushed 140 gal. water Screen: 2-in PVC, Sch 80, Thrd, .025-in slot, 25-30 ft Seal: Bentonite 1

Soil Samples: Split Spoon Grout: Portland 0-19 ft.

Geophysical Logs: none Chem. Analysis: Inorganic & Organic

	Elev.	Depth Ft.	TOC= LS= Description
			Silt, red/brown, loose-to-firm, slightly clayey, with fine to medium grained, quartzose sand, some muscovite flakes and weathered feldspar fragments, some organic material. Fill.
	SS		Silt, as above
		8.5	
	SS		Sand, orange/white, firm, with very fine to coarse grained quartz and feldspar fragments, silty, some biotite and muscovite, highly weathered.
	SS		Sand, as above, yellow/brown, large feldspar fragments, silty.
	SS		Sand, red/brown, firm, with very fine to coarse grained quartz and feldspar grains, large feldspar fragments not as numerous, heavily muscovitic, moist, highly weathered.
	SS	23.5	Saprolite, red/brown, white, mottled, quartzose and feldspathic grains and fragments, feldspars are soft, heavily weathered, dark minerals-augite, in fragments, very silty, very fine rock fragments.
		27.0	Saprolite, white to brown, quartzose and feldspathic grains and fragments, feldspars firmer, abundant muscovite, sand grains predominantly coarse, biotite flakes - very fine, heavily weathered.
	SS	30.0	
			Boring terminated at 30 ft.
			SS = Split-Spoon Sample

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-1A(T

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 10 ft Static Water Level: None

Date Completed: 10/12/82 Well Depth: Abandoned Permeability Tests: None

Drilling Method: Auger Casing: None

Development Method: None Screen: None Seal: None

Soil Samples: Split Spoon Grout: None

Geophysical Logs: None Chem. Analysis: None

Elev.	Depth Ft.	TOC= LS= Description
		Silt, red/brown, finely to medium sandy, quartzose, some muscovite flakes.
SS	3.5	Garbage, wood debris, cans.
SS	6.0	Sand, red/brown, very fine-to-coarse grained, subangular, very silty, gneissic composition.
SS	9.0	Debris hindering drilling - 9.3 ft.
	10.0	Abandoned test hole at 10 ft. due to garbage and debris.

SS = Split-Spoon Sample

SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-1B(

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 45 ft. Static Water Level: 20.5 ft

Date Completed: 10/12/82 Well Depth: 45 ft. Permeability Tests: Falling Head

Drilling Method: Auger Casing: 2-in. PVC Sch 80 Thrd. 0-40 ft.

Development Method: Flushed 100 gal. water Screen: 2-in PVC Sch 80 Thrd. .025-in. slot 40-45 ft. Seal: Bentonite, 36-38 ft.

Soil Samples: Split Spoon Grout: Portland, 0-36 ft.

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

Elev.	Depth Ft.	TOC= LS= Description	Blows per ft. (3 10 20 30 40 60 80)
		Fill, silt, wood debris, charcoal, glass.	
SS			
		Fill, as above.	
		Water table at approximately 13 ft in borehole.	
	15.0		
SS		Clay, grey, firm, sticky, silty, some muscovite flakes, with large amounts of imbedded medium-to-coarse grained, subangular sand.	
		Clay, medium brown, grey, mottled, soft-to-firm, sticky, slightly silty, with some muscovite flakes, sand content very low, medium- to-coarse grained, very faint oil odor.	
SS			
		Clay, as above, plastic, no odor; grading to	
SS			
	25.5	Silt, blue/grey, very clayey, plastic and sticky, with very small amounts of fine grained sand. Very loose, muscovitic, sand content increasing at 28 ft.	
	28.0		
SS			
	33.0	Sand blue/grey, very fine, some coarse grained, subrounded to subangular, moderately sorted, very silty, slightly clayey, muscovite.	
SS			

SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

Location: The Singer Co.- Lenoir County: Caldwell, NC Job No.: 4482-129 Boring or Well No.: W-18(

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/12/82 Boring Depth: 45 ft. Static Water Level: 20.5 ft

Date Completed: 10/12/82 Well Depth: 45 ft. Permeability Tests: Falling Head

Drilling Method: Auger Casing: 2-in. PVC Sch 80 Thrd. 0-40 ft.

Development Method: Flushed 100 gal. water Screen: 2-in PVC Sch 80 Thrd, .025-in. slot, 40-45 ft. Seal: Bentonite, 36-38 ft.

Soil Samples: Split Spoon Grout: Portland, 0-36 ft.

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

	Elev.	Depth Ft.	TOC= LS= Description	Blows per ft. 5 10 20 30 40 60 80
		37.0	Silt, grey, with some fine grained sand.	
	SS	39.0	Sand, light yellow/brown, to red/brown from staining, very fine to coarse, predominantly medium grained, subangular, poorly sorted, very slightly silty, muscovite and biotite flakes-fine, some orange oxide stains; grading to medium-to-coarse grained sand at 43.5 ft; large gravelly layer, subangular to rounded at 44.5 ft, imbedded with medium-to-coarse grained sand, muscovite and biotite flakes present.	
	SS	43.5		
		44.5		
		45.0	Boring terminated at 45 ft.	

SS = Split-Spoon Sample

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

The Singer Co.

Location: Lenoir County Caldwell, NC Job No.: 4482-129A Boring or Well No. E-1(

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: _____ Lat.-Long.: _____

Date Started: 10/13/82 Boring Depth: 35 ft Static Water Level: 9.9 ft

Date Completed: 10/13/82 Well Depth: 32 ft Permeability Tests: Falling Head

Drilling Method: Auger Air Casing: 2-in PVC Sch 80 Thrd, 0-27 ft

Development Method: Compressor Screen: 2-in PVC Sch 80 Thrd, .025-in slot, 27-32 ft Seal: Bentonite 23-25 ft

Soil Samples: Split-Spoon Grout: Portland, 0-23 ft

Geophysical Logs: None Chem. Analysis: Inorganic & Organic

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. FALLING 30 IN. REQUIRED TO DRIVE 1 S.M.S.D. SAMP.

	Elev.	Depth Ft.	TOC= LS= Description	Penetration — Blows per ft. (2 10 20 30 40 60)
			Fill, silt, rock fragments, muscovite flakes, debris.	
	SS			
		5.5	Clay, dark grey, soft-firm, sticky-plastic, slightly silty, with some fine grained imbedded sand, muscovite flakes present.	
	SS			
	SS		Clay, blue/grey, soft, sticky-plastic, slightly silty, with some imbedded medium-to-coarse grained sand, quartzose, abundant muscovite flakes.	
		13.5	Silt, blue/grey, soft, very clayey, with some imbedded medium-to-coarse grained sand, quartzose, abundant muscovite flakes.	
	SS			
	SS	19.0	Sand, grey, very fine-t-fine grained, some medium grained, subangular, very silty, clayey, poorly sorted, abundant muscovite flakes; interbedded with small silt layers containing very fine sand.	
	SS	24.5	Sand, grey, loose, very fine-to-fine grained, some medium grained, subrounded to subangular, slightly silty, slightly clayey, moderately sorted, muscovite flakes present.	
	SS	29.5	Sand, light yellow, with some orange/brown staining, medium-to-coarse grained, subangular, very slightly silty, moderately sorted, muscovite-biotite in fine particals, some oxide staining.	
	SS	33.5	Sand, fine grained to large gravel, yellow/brown, slightly silty, very poorly sorted, abundant gold muscovite flakes, biotite, quartz and feldspar fragments.	
		35.0	Boring terminated at 35 ft.	

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: The Singer Co.-Lenoir County: Caldwell, N.C. Job No.: 4482-129 Boring or Well No.: N-

Logged by: C. Gorman Drilled by: C. Silkwood Grid Coord.: 21.5 ft. Lat.-Long.:

Date Started: 10/11/82 Boring Depth: 21.5 ft Static Water Level: 10.4 ft

Date Completed: 10/12/82 Well Depth: 19.7 ft. Permeability Tests: Falling Hea

Drilling Method: Auger Casing: 2-in PVC, Sch 80 Thrd, 0-9.7 ft.

Development Method: Flushed 100 gal. water Screen: 2-inch PVC Sch 80 Thrd, .025-in slot 9.7 - 19.7 SEAL: Bentonite 6.

Soil Samples: Split Spoon Grout: Portland 0-6.5 ft.

Geophysical Logs: none Chem. Analysis: Inorganic & Organic

Elev.	Depth Ft.	TOC= LS= Description
		Silt, red/brown, with very fine grain, some coarse grained, quartzose, subangular sand, strong propellant odor.
	3.5	Silt, light red/brown, with very fine grain, some coarse grained, quartzose, subangular sand, clayey, micaceous, feldspar grains, strong propellant odor, rags and debris from 4.5 to 5.0 ft.
SS	4.5	
	5.0	Clay, grey/black, firm, sticky, with some imbedded very fine-to-fine, some coarse grained sand, very fine muscovite flakes, some organic material and rag fibers.
SS		
	8.0	Sand, grey/black, loose, very fine-to-medium grained, slightly silty, predominately quartzose, some feldspathic grains, subrounded to subangular, moderately sorted, abundant muscovite, no odor, wet.
SS		
	12.0	Silt, grey, with fine-grained sand, grading to silty sand.
SS	14.0	Sand, grey, fine-to-very coarse grained, firm, predominantly quartzose, some feldspathic grains, subrounded to subangular, poorly sorted, some muscovite flakes, larger grains are angular.
SS	20.0	Grading to brownish-grey silty sand at 20 ft.
	21.5	Boring terminated at 21.5 ft.

SS = Split-Spoon Sample

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: Singer Co. Plant#3 County: Caldwell, NC Job No.: 4483-129A Boring or Well No.: N

Logged by: C.Gorman Drilled by: H.Howard Grid Coord.: J74-g7 Lat.-Long.:

Date Started: 8/2/83 Boring Depth: 35 ft. Static Water Level: 7.3 ft.

Date Completed: 8/2/83 Well Depth: 21.2 Permeability Tests: Falling Head

Drilling Method: Mud Rotary Casing: 2-in PVC Schd 40, flush thd 0-10 ft.

Development Method: Screen: 2-in PVC Sch 40 thd, 0.015-in slots, 10-20 ft. Seal: Bent. 6-8

Soil Samples: Split-spoon Grout: Portland cem, 0-6 ft.

Geophysical Logs: Chem. Analysis:

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. WT. FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLE

PISTON SAMPLE — WATER TABLE

UNDISTURBED SAMPLE — WATER

±1064 Elev.	Depth	TOC=1069.84 LS=1066.95 Description	PENETRATION — BLOWS PER FT. 3 10 20 30 40 60 80
		Brown SAND, fine to very fine, loose; with abundant SILT and muscovite, with rooted organics.	
	7	Dark Gray, SAND, fine to very fine, loose; with some SILT and abundant muscovite, some organics. Water table at about 8 ft. in borehole.	
	11	Interbedded dark gray SAND, fine to very fine, very loose with SILT and abundant muscovite; and light gray SAND, medium to coarse, angular to subangular, very loose, mostly quartzose with some feldspar; some decomposing wood fragments. Severe caving at 18.5-20 ft. Pulled auger and switched to mud rotary drilling.	
	22	Grades to underlying	
G.S.		Dark gray CLAY, very soft, plastic; with small amounts of very fine SAND, abundant muscovite and some wood fragments.	
	26	Gray SAND, very fine to mostly medium to coarse SAND, subrounded to angular, with some gravel to 1-in, subangular to subrounded, very firm; with abundant muscovite and dark minerals. Hard drilling from 26 - 31 ft.	
G.S.			
	34	Mottled white and black SAPROLITE, very fine to medium grained, very firm, consisting of quartz, feldspar, amphibole and muscovite.	

Boring Terminated @ 35 ft.

SOIL & MATERIAL ENGINEERS, INC.

SOIL BORING AND WELL RECORD

Location: Singer Co. Plant #3 Lenior County: Caldwell, NC Job No.: 4483-129A Boring or Well No.: NE-1

Logged by: C. Gorman Drilled by: H. Howard Grid Coord.: J74-g8 Lat.-Long.:

Date Started: 8/3/83 Boring Depth: 35 ft. Static Water Level: 5.5 ft.

Date Completed: 8/3/83 Well Depth: 30.3 ft. Permeability Tests:

Drilling Method: Power Auger Casing: 2-in. PVC Sch 40, flush thd., 0-25.3 ft.

Development Method: Screen: 2-in PVC Sch 40 thd., ~~0-0.15-in slots, 25.5-30.5 ft~~ Seal: Bent., 19-

Soil Samples: Split-spoon Grout: Portland cem. 0-19 ft.

Geophysical Logs: Chem. Analysis:

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 IN REQUIRED TO DRIVE 1.4 IN I.D. SAMPLER

NS SAMPLE — WATER TABLE

UNDISTURBED SAMPLE — MATERIAL

	Elev.	Depth	TOC=1070.65 LS=1067.88 Description	PENETRATION — BLOWS PER FT. 5 10 20 30 40 60 80
			Brown SAND, very fine to fine, loose; with some SILT and muscovite, some rooted organics.	
		7	Gray CLAY, soft; with very fine to fine SAND, and abundant muscovite, with some organics.	
	G.S			
		17	Gray SAND, very fine to medium, loose, subangular; with slight SILT content, and abundant muscovite, and dark minerals. Water Table was encountered at about 17 ft. and rose up auger hole.	
		21	Dark gray SILT and CLAY, very soft; with very fine SAND and abundant muscovite.	
	G.S	23	Brown to gray SAND, fine to mostly medium to coarse, loose, quartzose subangular; with some gravel at 29 ft., with some mica and dark minerals.	
		34	Mottled white and brown SAPROLITE, very fine to medium grained, very firm, consisting of quartz, feldspar, amphibole and muscovite.	

Boring Terminated 0 35 ft.

SOIL & MATERIAL ENGINEERS, INC.
SOIL BORING AND WELL RECORD

cation: Singer Co. Plant#3 Lenoir, N.C. County: Caldwell Job No.: 4483-129A Boring or Well No.: W-2

gged by: C. Corman Drilled by: H. Howard Grid Coord.: J74-g6 Lat.-Long.:

ate Started: 8/2/83 Boring Depth: 35 ft. Static Water Level: 10.2 ft.

ate Completed: 8/2/83 Well Depth: 28 ft. Permeability Tests:

rilling Method: Power Auger Casing: 2-in PVC, Sch 40, flush thd, 0-28 ft.

evelopment Method: Air comp. Screen: ~~0.015-in slot, thd 23-28 ft.~~ 2-in PVC Sch 40, thd Seal: Bent, 19-21 ft

oil Samples: Split-spoon Grout: Portland cem, 0-19 ft.

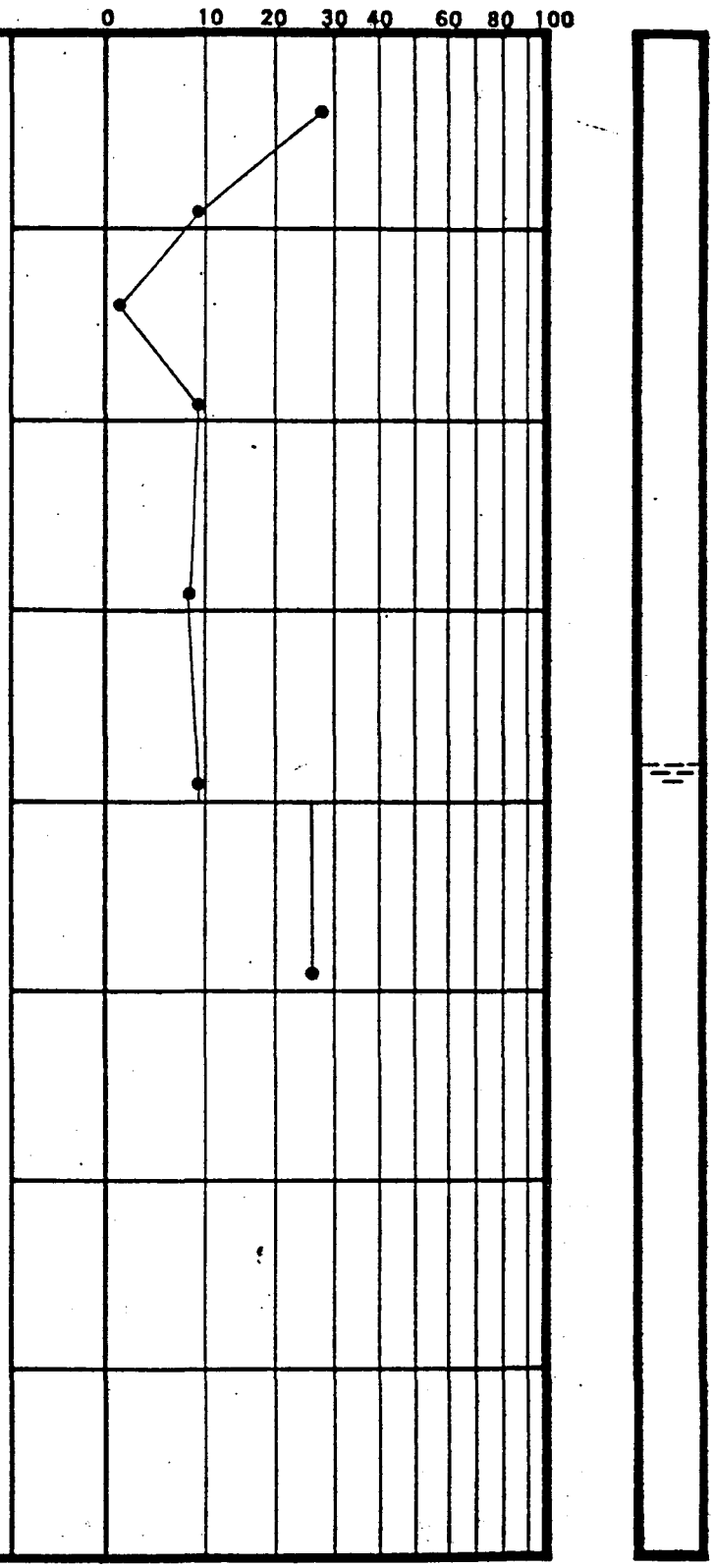
eophysical Logs: Chem. Analysis:

Elev.	Depth	TOC=1074.27 LS=1071.02 Description	Penetration Resistance (Blows per ft.) 5 10 20 30 40 60 80
		Reddish-brown, SAND, fine-grained, very loose; with some CLAY and abundant muscovite and some wood debris and garbage (FILL).	4
	7	Gray CLAY, very soft; with some very fine SAND and some SILT, and abundant muscovite.	2
	12	Gray SAND, fine to mostly medium to coarse, loose, subangular to subrounded with abundant muscovite and some dark minerals. Water table at about 12 ft. in borehole.	5
	19	Grades to Dark gray CLAY, very soft; with SILT and very fine SAND and abundant muscovite.	2
	21	Brownish-gray SAND, very fine to mostly medium to coarse, loose, subangular; with abundant muscovite and dark minerals; with thin lenses of sandy SILT and CLAY.	7
G.S.	31	Reddish-orange SAND, very fine to medium, subangular, firm arkosic, with abundant muscovite and dark minerals, slightly silty.	19
G.S.			

Boring Terminated @ 35 ft.

DEPTH	DESCRIPTION
0	(Fill) Brown Clayey Fine to Coarse Sandy Silt With Rock And Wood Fragments to Black Silty Fine to Coarse Sand With Wood, Glass and Rock Fragments
13.0	(Fill or Possible Alluvium) Firm to Stiff Tan Brown to Blue Gray and Tan Micaceous Fine to Medium Sandy Clayey Silt
20	(Residual) Firm Gray Green Micaceous Silty Fine to Medium Sand
25.0	Boring Terminated At 25.0 Feet Groundwater Encountered At 19 Feet At Time of Boring

● PENETRATION-BLOWS PER FT.



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-1

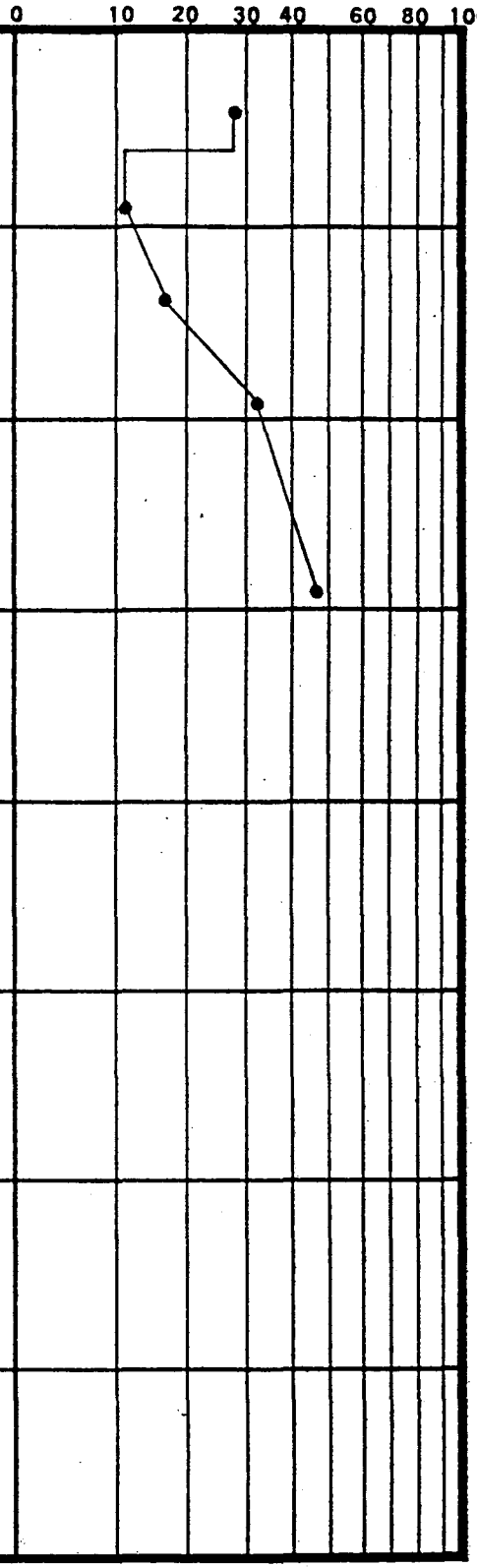
DATE DRILLED 8/31/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH FT	DESCRIPTION
	(Fill) Green Gray Micaceous Silty Fine to Coarse Sand With Rock Fragments
3.0	(Residual) Firm Green Gray Very Micaceous Silty Fine Sand to Gray Brown and White Micaceous Silty Fine Sand
0	Dense Gray Brown to Green Gray Silty Fine to Coarse Sand
5.0	Boring Terminated At 15.0 Feet No Groundwater Encountered At Time of Boring

● PENETRATION-BLOWS PER FT.



TING AND SAMPLING MEETS ASTM D-1586

E DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-2

DATE DRILLED 8/31/78

JOB NO. CH 4155

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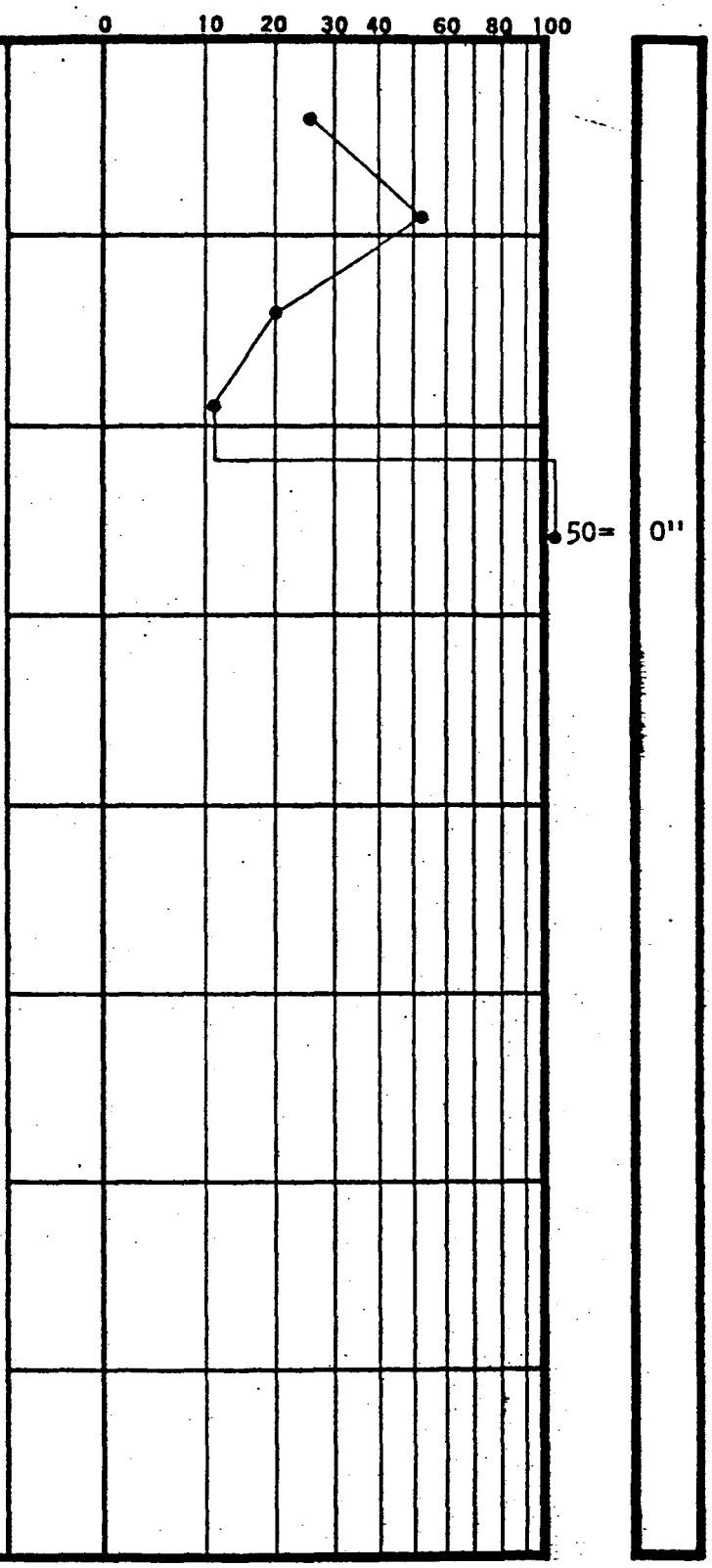
LAW ENGINEERING TESTING COMPANY

DEPTH	DESCRIPTION
0	Crushed Stone
.0	(Fill) Gray Green Micaceous Silty Fine to Coarse Sand With Rock Fragments
8.0	(Fill or Possible Alluvium) Tan Brown Fine to Coarse Sandy Silty Clay With Rounded Gravel
11.0	(Possible Residual - No Samples Obtained)
13.0	Auger Refusal At 13.0 Feet Boring Terminated At 13.0 Feet No Groundwater Encountered At Time of Boring

● PENETRATION-BLOWS PER FT.



RING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-3

DATE DRILLED 8/31/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH T.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
	Augered From 0 to 8.5 Feet Without Soil Sampling	
8.5	(Fill) Red Brown Fine to Coarse Sandy Clayey Silt With Rock Fragments	●
10.0	(Possible Fill) Tan Gray Silty Fine to Coarse Sand With Rock Fragments	
12.0	Auger Refusal At 12.0 Feet Boring Terminated At 12.0 Feet No Groundwater Encountered At Time of Boring	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-3A

DATE DRILLED 8/31/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)		
0	(Fill) Red Tan Micaceous Fine to Coarse Sandy Clayey Silt With Rock Fragments		50=	6"
	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours			

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-4

DATE DRILLED 9/1/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Red Tan Micaceous Fine to Coarse Sandy Clayey Silt With Rock Fragments	
3.5	Auger Refusal At 3.5 Feet Boring Terminated At 3.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-4A

DATE DRILLED 9/1/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
0	(Fill) Brown Fine to Coarse Sandy Clayey Silt With Rock Fragments	
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-4B

DATE DRILLED 9/1/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Green Gray Micaceous Silty Fine to Coarse Sand With Rock Fragments	
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-5

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
0	(Fill) Red Brown Micaceous Clayey Silty Fine to Coarse Sand With Rock Fragments	
3.5	Auger Refusal at 3.5 Feet Boring Terminated at 3.5 Feet No Groundwater Encountered at Time of Boring No Groundwater Encountered After 24 Hours	

RING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-5A

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100	
	(Fill) Rock Fragments	50=	0"
3.5	Auger Refusal At 3.5 Feet Boring Terminated At 3.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
ORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-6

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)
	(Fill) Green Brown Silty Fine to Coarse Sand With Rock Fragments	
6.0	Auger Refusal At 6.0 Feet Boring Terminated At 6.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-6A
DATE DRILLED 9/5/78
JOB NO. CH 4155
PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)	
	(Fill) Blue Gray Slightly Silty Fine to Coarse Sand With Rock Fragments	●50=	6"
5.5	Auger Refusal At 5.5 Feet Boring Terminated At 5.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-7

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Red Brown Silty Fine to Coarse Sand With Rock Fragments	
4.5	Auger Refusal At 4.5 Feet Boring Terminated At 4.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-7A

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)	
	(Fill) Red Brown Silty Fine to Coarse Sand With Rock Fragments	●50=	0"
2.5	Auger Refusal At 2.5 Feet Boring Terminated At 2.5 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-8

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	(Fill) Red Brown Silty Fine to Coarse Sand With Rock Fragments	
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-8A

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)	
0	(Fill) Brown Silty Fine to Coarse Sand With Rock Fragments	●50=	0"
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-9

DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH	DESCRIPTION	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Fill) Brown Silty Fine to Coarse Sand With Rock Fragments	
3.0	Auger Refusal At 3.0 Feet Boring Terminated At 3.0 Feet No Groundwater Encountered At Time of Boring No Groundwater Encountered After 24 Hours	

RING AND SAMPLING MEETS ASTM D-1586
E DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-9A

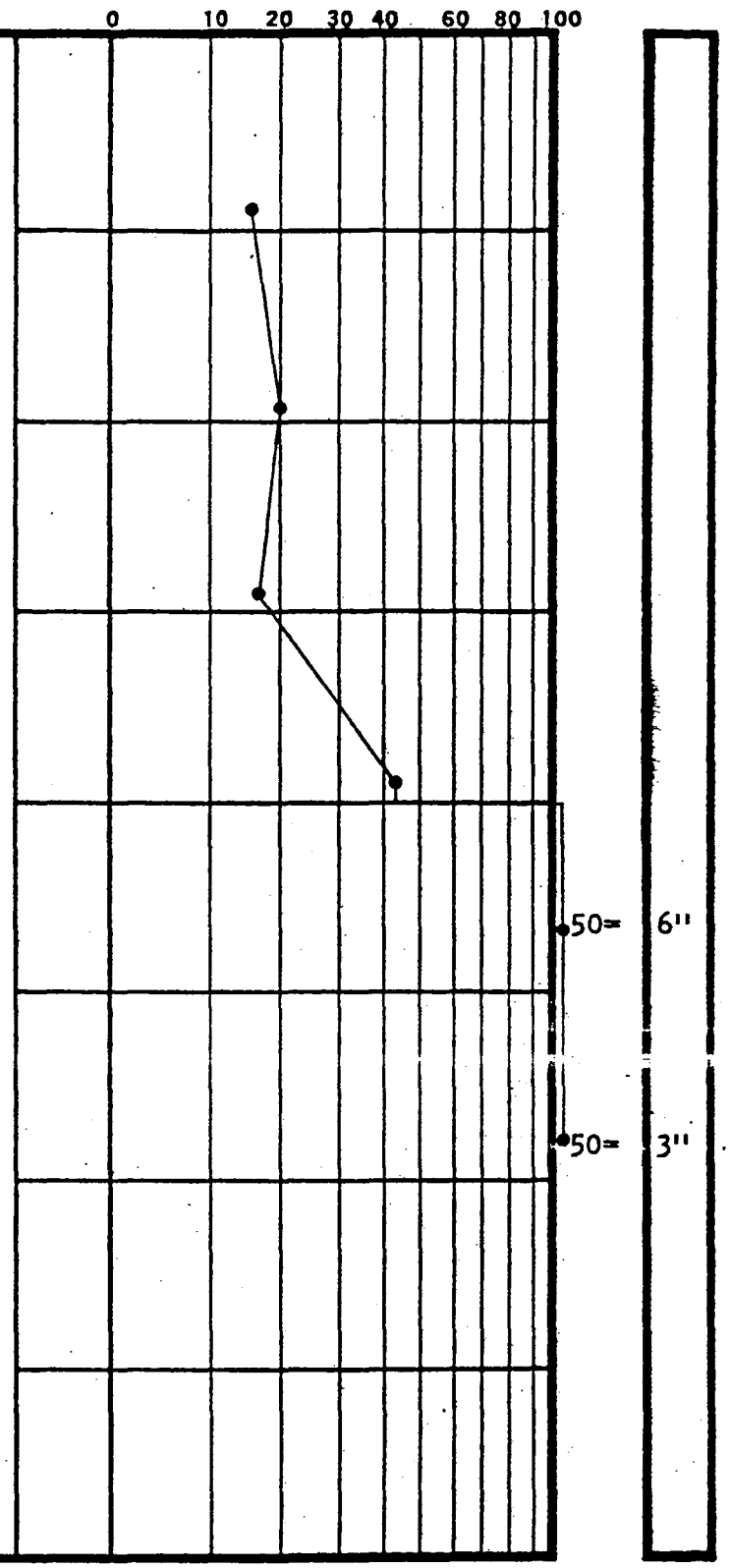
DATE DRILLED 9/5/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	(Residual) Firm Tan Brown Micaceous Silty Fine to Medium Sand
.0	Dense Green Brown Micaceous Silty Fine to Coarse Sand
.0	Partially Weathered Rock Sampled As Green Brown to Blue Gray And Tan Micaceous Silty Fine to Coarse Sand
.0	Auger Refusal At 31.0 Feet Boring Terminated At 31.0 Feet No Groundwater Encountered At Time of Boring



BORING AND SAMPLING MEETS ASTM D-1586
RE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-10

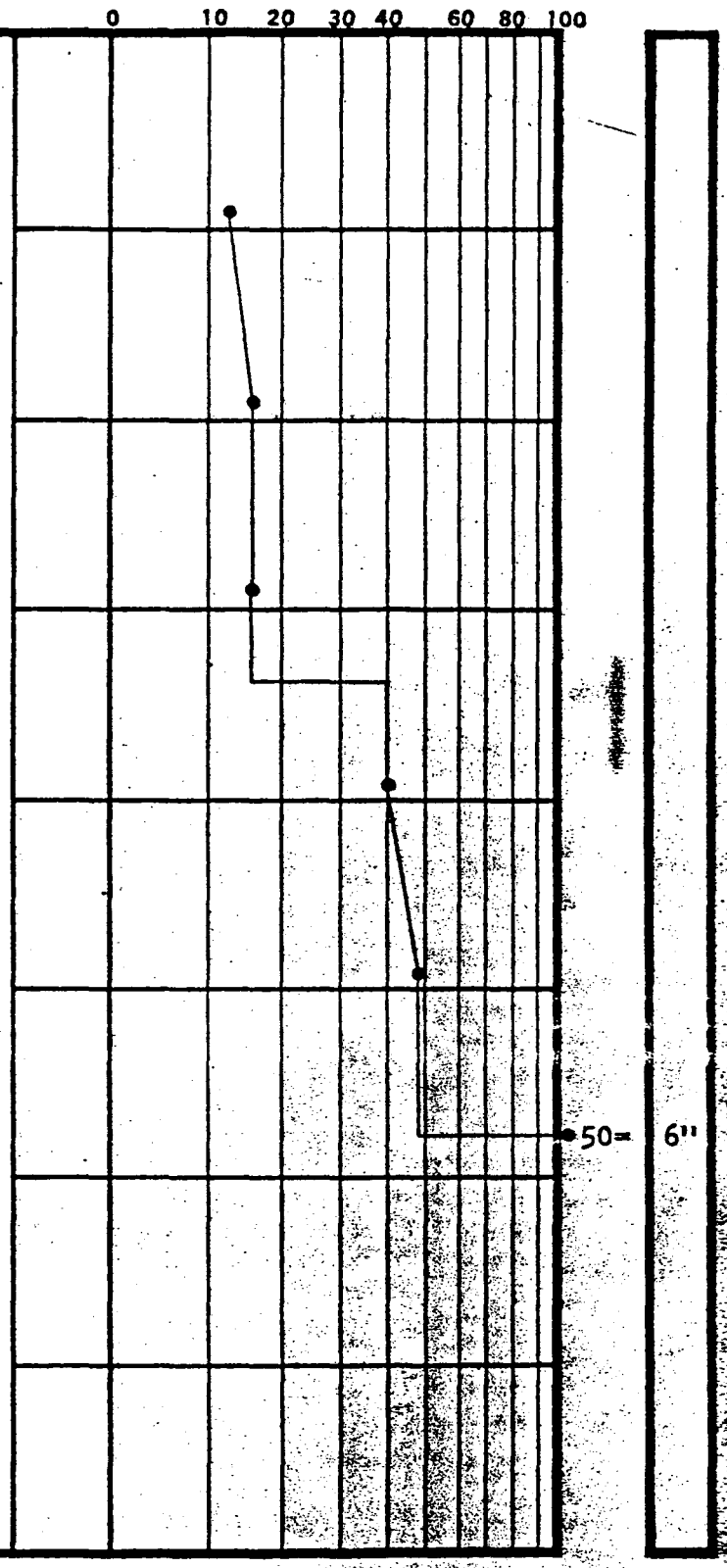
DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
0	(Residual) Stiff Tan Brown Micaceous Fine Sandy Silt
5.5	Firm Tan Brown And Green Gray Micaceous Silty Fine to Coarse Sand With Weathered Rock Fragments
17.0	Dense Blue Gray, Brown And White Micaceous Silty Fine to Medium Sand With Weathered Rock Fragments
29.0	*
29.5	Boring Terminated At 30.0 Feet No Groundwater Encountered At Time of Boring *Partially Weathered Rock Sampled As Blue Gray Silty Fine to Medium Sand



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

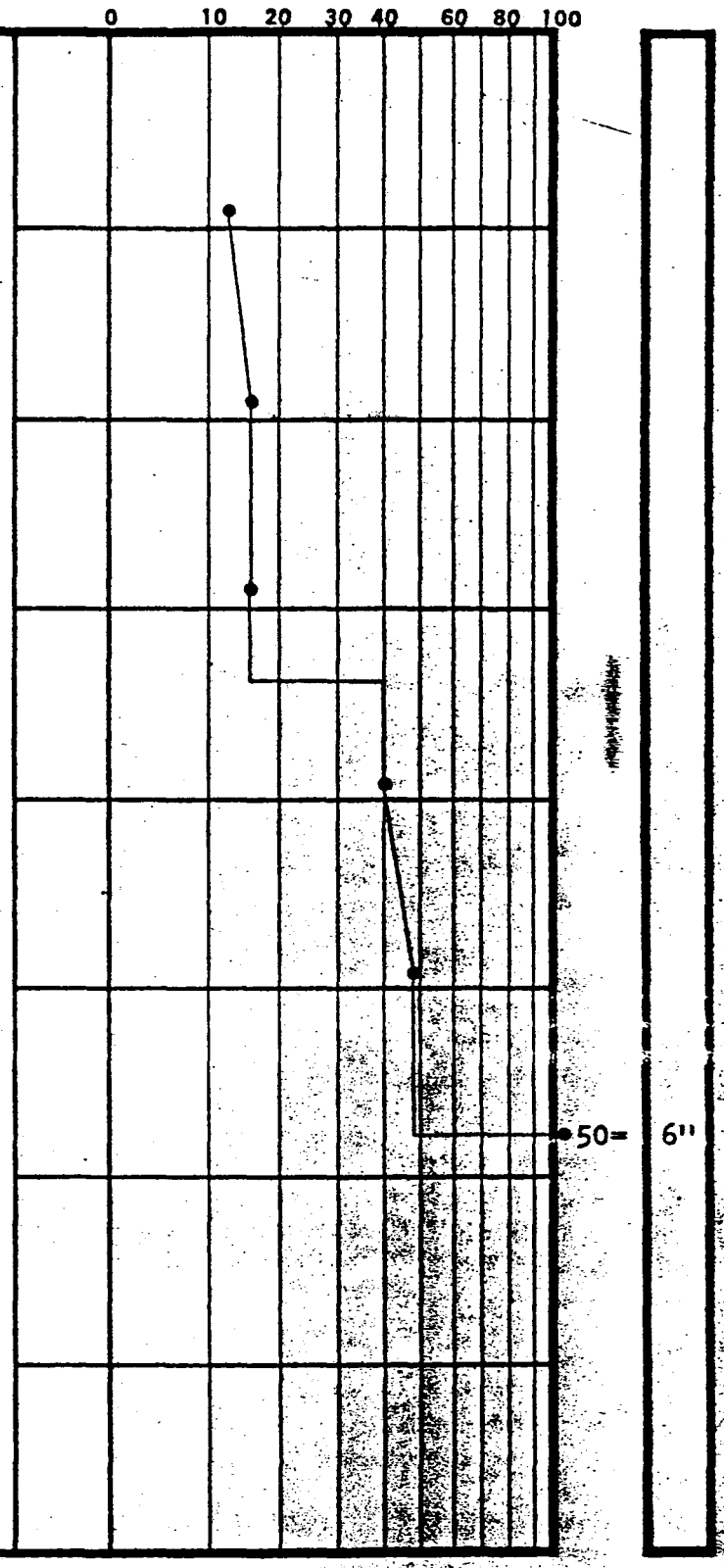
BORING NO. B-11

DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH FT.	DESCRIPTION
0	(Residual) Stiff Tan Brown Micaceous Fine Sandy Silt
5.5	Firm Tan Brown And Green Gray Micaceous Silty Fine to Coarse Sand With Weathered Rock Fragments
17.0	Dense Blue Gray, Brown And White Micaceous Silty Fine to Medium Sand With Weathered Rock Fragments
29.0	*
29.5	Boring Terminated At 30.0 Feet No Groundwater Encountered At Time of Boring *Partially Weathered Rock Sampled As Blue Gray Silty Fine to Medium Sand



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-11

DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

DEPTH FT.	DESCRIPTION	● PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)		
	(Residual) Firm Tan Brown Micaceous Silty Fine to Medium Sand			
'.0	Dense Green Brown Micaceous Silty Fine to Coarse Sand			
.0	Partially Weathered Rock Sampled As Green Brown to Blue Gray And Tan Micaceous Silty Fine to Coarse Sand		50=	6"
			50=	3"
0	Auger Refusal At 31.0 Feet Boring Terminated At 31.0 Feet No Groundwater Encountered At Time of Boring			

BORING AND SAMPLING MEETS ASTM D-1586
E DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

TEST BORING RECORD

BORING NO. B-10

DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING

DEPTH FT.	DESCRIPTION	PENETRATION-BLOWS PER FT. (0 10 20 30 40 60 80 100)	
	(Residual) Stiff Tan Brown Micaceous Fine Sandy Silt		
	Firm Tan Brown And Green Gray Micaceous Silty Fine to Coarse Sand With Weathered Rock Fragments		
	Dense Blue Gray, Brown And White Micaceous Silty Fine to Medium Sand With Weathered Rock Fragments		
	*	50=	6"
	Boring Terminated At 30.0 Feet No Groundwater Encountered At Time of Boring *Partially Weathered Rock Sampled As Blue Gray Silty Fine to Medium Sand		

BORING AND SAMPLING MEETS ASTM D-1586
E DRILLING MEETS ASTM D-2113

...ETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. B-11

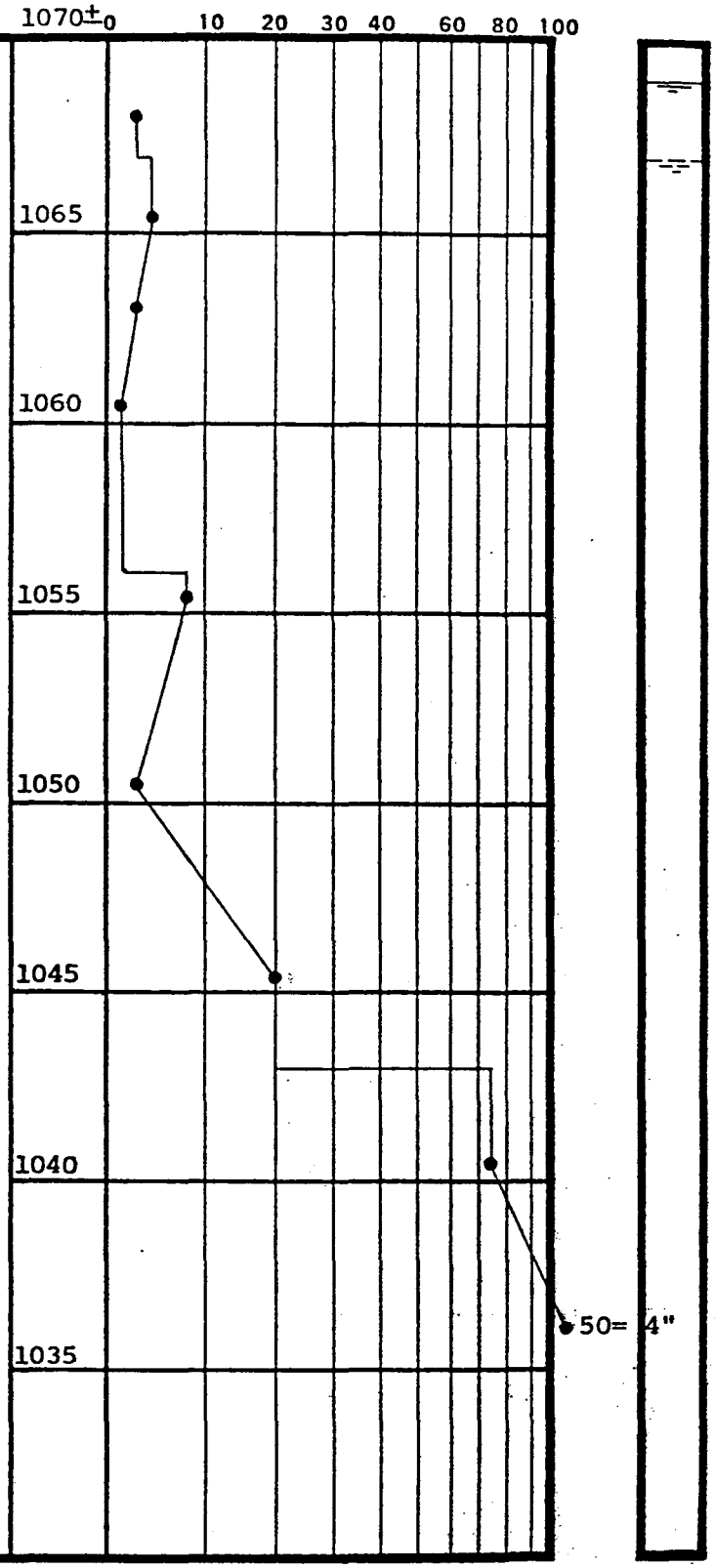
DATE DRILLED 9/6/78

JOB NO. CH 4155

PAGE 1 OF 1

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	(Fill or Possible Alluvium) Very Loose Gray Black Brown Micaceous Silty Fine to Coarse Sand
3.0	(Alluvium) Firm to Soft Blue Black Silty Clay With Wood Fragments and Decayed Organics
3.0	(Alluvium) Very Soft Blue Black Fine to Medium Sandy Clayey Silt With Decayed Organics and Coarse Sand and Gravel from 13.5 to 14 Feet
.0	(Residual) Loose Tan Brown Micaceous Clayey Silty Fine to Coarse Sand With Weathered Rock Fragments to Very Loose Tan Micaceous Silty Fine to Coarse Sand
	Firm Tan Brown Micaceous Silty Fine to Coarse Sand
.0	Very Dense Mottled Gray, Tan and White Micaceous Silty Fine to Medium Sand
.0	*
.3	Boring Terminated at 34.3 Feet Groundwater at 3 Feet at Time of Boring Groundwater at 1 Foot on 8/13/80



*Partially Weathered Rock Sampled As Green Tan Brown Micaceous Silty Fine to Coarse Sand

BORING AND SAMPLING MEETS ASTM D-1586

ORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-1

DATE DRILLED 8/8/80

JOB NO. CH 4467

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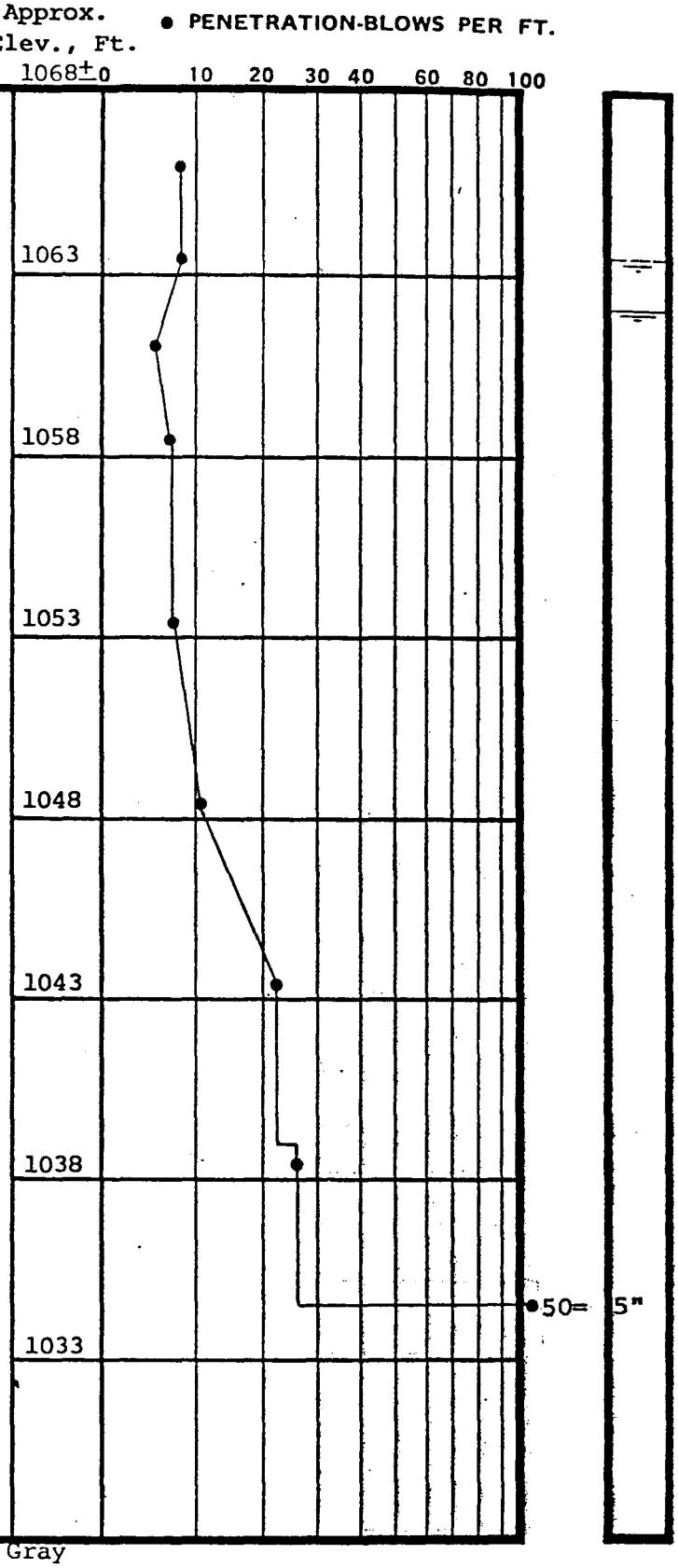
LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	Weeds and Topsoil	1068±
	(Alluvium) Firm Gray Tan Brown Slightly Micaceous Fine Sandy Silt	
3.0	(Alluvium) Loose Blue Tan Gray Micaceous Silty Fine to Medium Sand With Wood Fragments	1063
		1058
		1053
.0	(Alluvium) Firm Tan Blue Gray Micaceous Silty Fine to Medium Sand With Coarse Sand and Rounded Gravel at 28.5 Feet	1048
		1043
.0	(Residual) Firm Green and White Micaceous Silty Fine to Medium Sand	1038
.5	*	
.9	Boring Terminated at 33.9 Feet	1033
	Groundwater at 4.5 Feet at Time of Boring	
	Groundwater at 6 Feet on 8/13/80	



*Partially Weathered Rock Sampled as Blue Gray and White Silty Fine to Coarse Sand

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-2

DATE DRILLED 8/7/80

JOB NO. CH 4467

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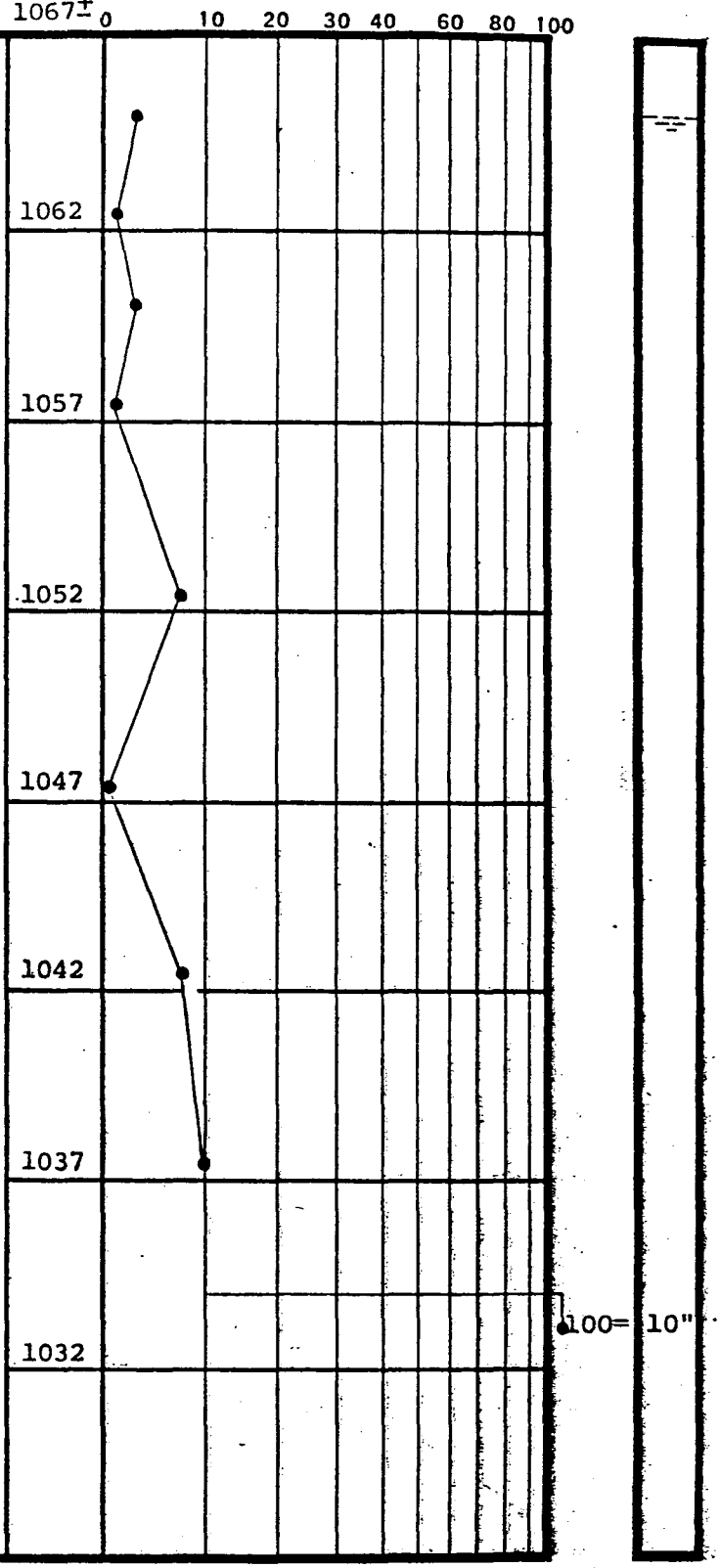
LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1067±
0	(Alluvium) Soft to Very Soft Tan Brown to Gray Tan Micaceous Clayey Fine Sandy Silt	1062
5.5	(Alluvium) Very Loose to Loose Tan Blue Gray Micaceous Silty Fine to Medium Sand With Decayed Organics	1057
		1052
7.0	(Alluvium) Very Loose Tan Blue Gray Micaceous Silty Fine Sand to Loose Tan Blue Gray Micaceous Silty Fine to Coarse Sand With Rounded Gravel Below 26.5 Feet	1047
		1042
9.5	(Residual) Loose Green and White Micaceous Silty Fine to Medium Sand	1037
3.0	Partially Weathered Rock Sampled As Green Brown and White Silty Fine**	
4.3	Boring Terminated at 34.3 Feet	1032

Groundwater at 2 Feet at Time of Boring and 5 Feet After Several Hours

*Topsoil
**to Coarse Sand



BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE
50 % ROCK CORE RECOVERY
WATER TABLE, 24 HR.
WATER TABLE, 1 HR.
LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-3
DATE DRILLED 8/12/80
JOB NO. CH 4467
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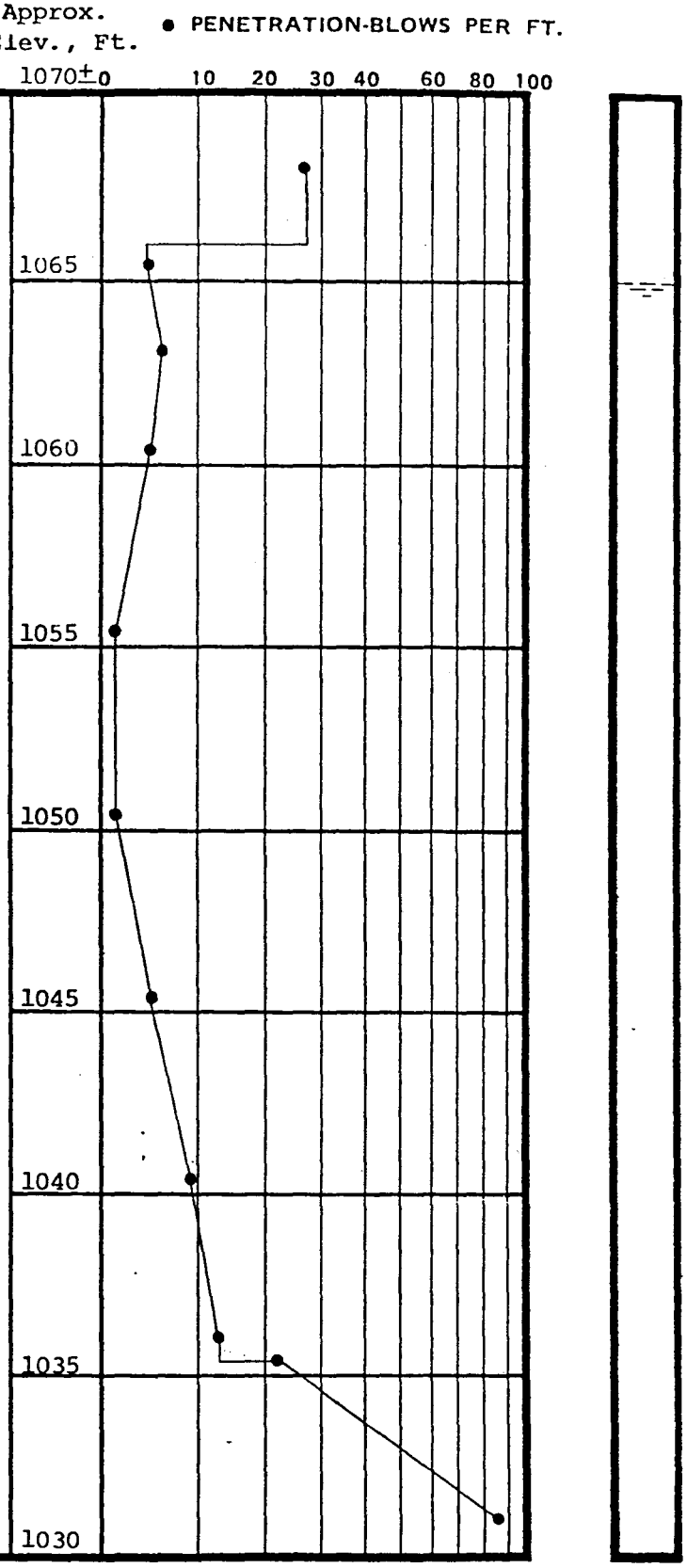
LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION
	(Fill) Gravel and Soil Mixture
	(Fill) Firm Brown Micaceous Silty Fine to Medium Sand
4.0	(Alluvium) Firm Blue Gray Micaceous Fine to Medium Sandy Silty Clay to Fine Slightly Sandy Silty Clay
12.0	(Alluvium) Very Soft Blue Gray Micaceous Fine Slightly Sandy Silty Clay With Silty Fine to Coarse Sand Seams
22	(Alluvium) Loose Tan Blue Gray Micaceous Silty Fine Sand
28.5	(Alluvium) Loose to Firm Gray Tan Silty Fine to Coarse Sand With Rounded Gravel. Larger Gravel and Cobbles From 33.5 to 34.5 Feet
34.5	(Residual) Firm Tan Brown Micaceous Silty Fine to Medium Sand
38.5	Very Dense Tan Brown Silty Fine to Coarse Sand
40.0	



Boring Terminated a5 40.0 Feet Groundwater Encountered at 5 Feet at Time of Boring

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-4

DATE DRILLED 8/8/80

JOB NO. CH 4467

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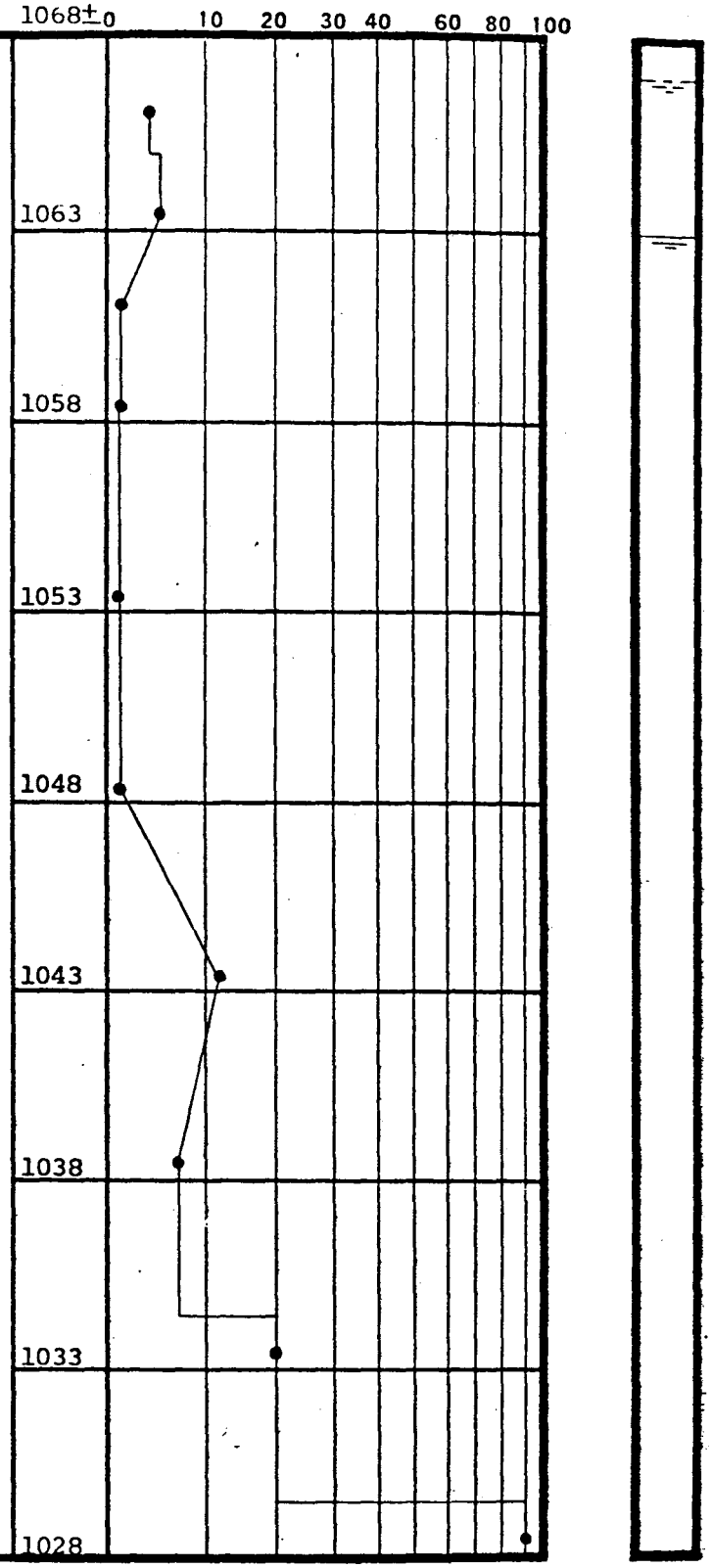
LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.
0	(Fill) Tan Micaceous Silty Fine to Medium Sand With Wood Chips and Trash	1068±
1	(Alluvium) Soft Gray Tan Brown Slightly Micaceous Fine Slightly Sandy Silt With Wood and Decayed Organics	
3.0	(Alluvium) Firm Tan Blue Gray Silty Clay	1063
5.0	(Alluvium) Very Soft Tan Blue Gray to Blue Gray Silty Clay	1058
		1053
		1048
20.0	(Alluvium) Firm Tan Brown Micaceous Silty Fine to Medium Sand to Loose Blue Tan Gray Micaceous Silty Fine to Medium Sand With Organics and Rounded Gravel Below 28.5 Feet	1043
		1038
33.5	(Residual) Firm Orange Tan to Gray, Green and White Micaceous Silty Fine to Medium Sand	1033
38.5	Very Dense Residual Soil (No Sample Recovery)	
40.0		1028



Boring Terminated at 40.0 Feet Groundwater at 1 Foot at Time of Boring

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

Groundwater at 5 Feet After 24 Hours

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

TEST BORING RECORD

BORING NO. BB-5

DATE DRILLED 8/12/80

JOB NO. CH 4467

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LAW ENGINEERING TESTING COMPANY

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1137±	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Residual) Pink Brown Micaceous Silty Fine Sand to Tan Micaceous Fine to Medium Silty Sand (No Split-Spoon Samples Obtained - Soil Descriptions From Samples of Auger Cuttings)	1132	
		1127	
		1122	
15.0	Residual Soil Sampled as Dense Red Tan Brown Micaceous Silty Fine to Medium Sand From 18.5 to 20.0 Feet and Firm Gray Tan Brown Micaceous Silty Fine to Medium Sand From 43.5 to 45.0 Feet	1117	●
		1112	
		1107	
		1102	
50.0		1097	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-6

DATE DRILLED 8/7/80

JOB NO. CH 4467

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1097±	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
1.0	esidual Soil Sampled as Dense Red an Brown Micaceous Silty Fine to Medium Sand From 18.5 to 20.0 Feet and Firm Gray Tan Brown Micaceous Silty Fine to Medium Sand From 43.5 to 45.0 Feet	1092	●
45.0	Boring Terminated at 45.0 Feet Groundwater at 40.5 Feet at Time of Boring Groundwater at 32.5 Feet on 8/12/80		

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

IETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER ALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-6

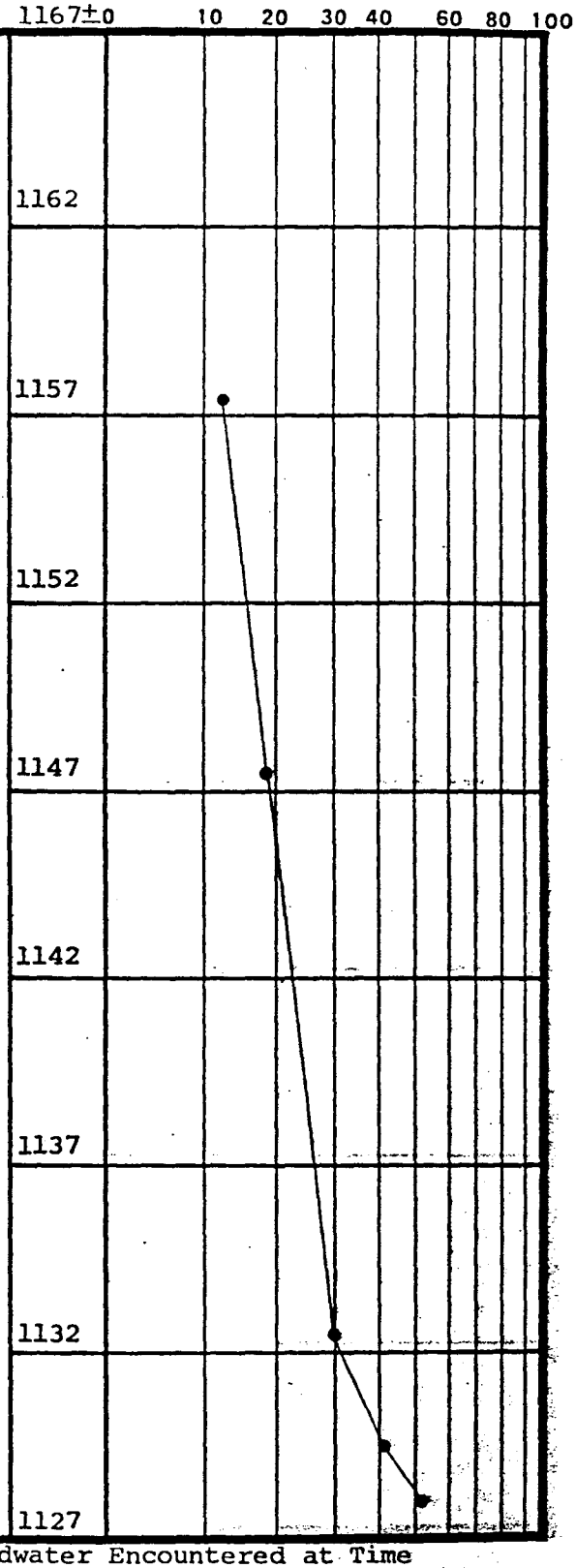
DATE DRILLED 8/7/80

JOB NO. CH 4467

PAGE 2 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1167±0
0	Topsoil and Roots	
"	(Residual) Red Brown Micaceous Slightly Clayey Fine to Medium Very Sandy Silt (No Split-Spoon Samples Obtained - Soil Description From Samples of Auger Cuttings)	1162
5.0	Firm Tan Brown Micaceous Silty Fine to Medium Sand to Fine to Coarse Sand	1157
		1152
		1147
		1142
		1137
		1132
36.0	Dense to Very Dense Tan White to Gray Tan White Silty Fine to Coarse Sand	
39.5	Refusal to Augers at 39.5 Feet	1127



*Boring Terminated at 39.5 Feet No Groundwater Encountered at Time of Boring Borehole Caved and Dry at 34 Feet After 24 Hours.

BORING AND SAMPLING MEETS ASTM D-1586

CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

TEST BORING RECORD

BORING NO: BB-7

DATE DRILLED 8/9/80

JOB NO. CH 4467

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LAW ENGINEERING TESTING COMPANY

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Residual) Red Brown Micaceous Fine Sandy Silt With Loose to Firm Consistency, Based on Driller's Assessment of Drilling Difficulty (No Split-Spoon Samples Obtained)	1165±	
		1160	
		1155	
		1150	
15.0	Red Tan Brown Micaceous Silty Fine to Medium Sand With Firm Consistency, Based on Driller's Assessment of Drilling Difficulty (No Split-Spoon Samples Obtained)	1145	
		1140	
		1135	
5.0		1130	
	Tan Brown Micaceous Silty Fine to Medium Sand With Estimated Firm to Dense Consistency (No Split-Spoon Samples Taken)		
).0		1125	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-7A

DATE DRILLED 8/11/80

JOB NO. CH 4467

PAGE 1/2 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. ±	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	Tan Brown Micaceous Silty Fine to Medium Sand With Estimated Firm to Dense Consistency (No Split-Spoon Samples Taken)	1125	
		1120	
		1115	
52.0	Tan Brown Micaceous Silty Fine to Medium Sand With Estimated Very Dense Consistency	1110	
55.0	Partially Weathered Rock As Estimated by Driller	1105	
63.1	Refusal to Rotary Drag Bit at 63.1 Feet Boring Terminated at 63.1 Feet	1100	● 50= 0

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-7A

DATE DRILLED 8/11/80

JOB NO. CH 4467

PAGE 2 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft.	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
0	(Residual) Red Brown Micaceous Fine Sandy Silt With Loose Consistency, Based on Driller's Assessment of Drilling Difficulty (No Split-Spoon Samples Obtained)	1160±	
		1155	
		1150	
13.0	Red Tan Brown to Tan Brown Micaceous Silty Fine to Medium Sand With Firm Consistency Based on Split-Spoon Sample from 13.5 to 15.0 Feet and Driller's Assessment of Drilling Difficulty in Soils Below	1145	●
		1140	
		1135	
		1130	
		1125	
40.0		1120	

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

ENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-8

DATE DRILLED 8/12/80

JOB NO. CH 4467

PAGE 1 OF 2

LAW ENGINEERING TESTING COMPANY

DEPTH FT.	DESCRIPTION	Approx. Elev., Ft. 1120±	● PENETRATION-BLOWS PER FT. 0 10 20 30 40 60 80 100
	Red Tan Brown to Tan Brown Micaceous Silty Fine to Medium Sand With Firm Consistency Based on Split-Spoon Sample from 13.5 to 15.0 Feet and Driller's Assessment of Drilling Difficulty in Soils Below	1115	
		1110	
		1105	
57.5	Partially Weathered Rock Sampled As Green Tan Brown Micaceous Silty Fine to Coarse Sand	1100	
63.8	Boring Terminated at 63.8 Feet	1095	● 50= 3"

BORING AND SAMPLING MEETS ASTM D-1586
CORE DRILLING MEETS ASTM D-2113

PENETRATION IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I. D. SAMPLER 1 FT.

UNDISTURBED SAMPLE

50 % ROCK CORE RECOVERY

WATER TABLE, 24 HR.

WATER TABLE, 1 HR.

LOSS OF DRILLING WATER

TEST BORING RECORD

BORING NO. BB-8

DATE DRILLED 8/12/80

JOB NO. CH 4467

PAGE 2 OF 2

LAW ENGINEERING TESTING COMPANY